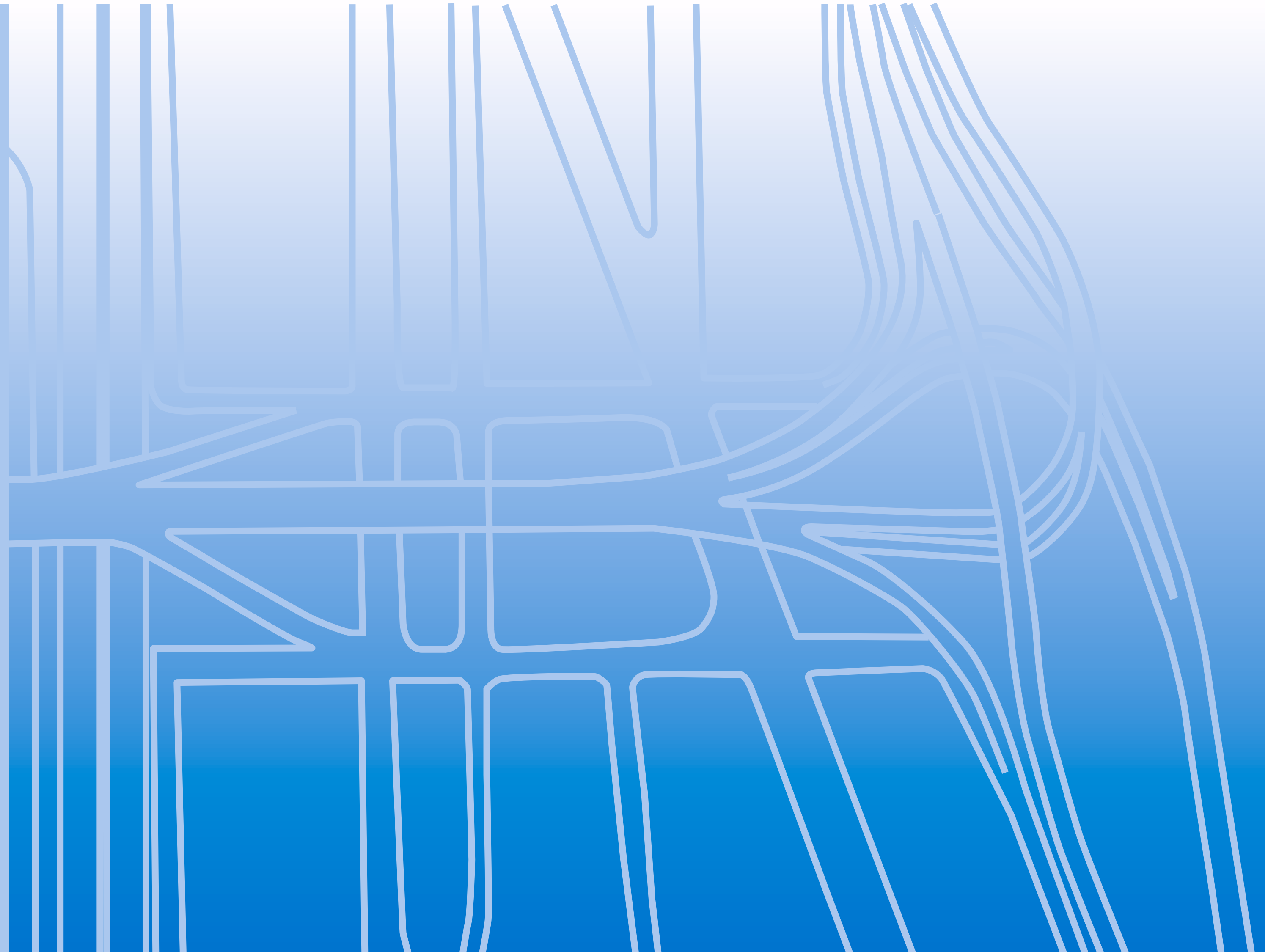

# MASSACHUSETTS TURNPIKE BOSTON RAMPS AND BOWKER OVERPASS STUDY

massDOT
Massachusetts Department of Transportation

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10 Park Plaza
Boston, MA 02116
857-368-8580
TTY: 857-368-0603
MASSDOT.CivilRights@state.ma.us

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Massachusetts Commission Against Discrimination (MCAD)
One Ashburton Place, 6th Floor
Boston, MA 02109
617-994-6000
TTY: 617-994-6196

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# Executive Summary

## Introduction

This report summarizes the findings of the Massachusetts Turnpike Boston Ramps and Bowker Overpass Study. The Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP) sponsored this study.

Historically, the responsibility for studying key highway and arterial systems was divided between several state organizations, including the Massachusetts Turnpike Authority, the Department of Conservation and Recreation, and the Massachusetts Highway Department. The creation of MassDOT in 2009, which consolidated state transportation agencies and functions, allowed MassDOT to study and develop proposed improvements to all of the interconnected roadway systems in the study area (see Chapter 1 Section 1.3 for a description of the study area). This work was undertaken with the cooperation of key stakeholders in the city of Boston and of the public at large.

## The Origin of This Study

The subject of new ramps and better access to the urban districts was revisited by MassDOT. Metropolitan planning organization (MPO) staff were retained to perform modeling and to provide other technical support. Initially, the analysis focused on identifying access points for entering the eastbound Massachusetts Turnpike (I-90) and for exiting westbound I-90 at points convenient to Back Bay locations. The scope of the project was later expanded to address regional connectivity issues, such as access to the Turnpike from the Longwood Medical and Academic Area (LMA). The initial results of traffic modeling for the study area were presented at a public meeting at the Boston Public Library.

At the public meeting, it became evident that the vicinity of the Bowker Overpass would be an important nexus in the next phase of MassDOT's study. Several factors pointed to this conclusion:

- By including the LMA in the study area, access to the Massachusetts Turnpike near Kenmore Square would become a more important consideration.
- The Bowker Overpass, built at the same time as the Boston Extension, needed significant refurbishment, making reconsideration of its design and function timely.
- Adding new ramps to access the Massachusetts Turnpike would allow a reevaluation of the relationship between traffic on Storrow Drive and traffic on the Massachusetts Turnpike, and the Bowker Overpass and ramps are located where these two roadway systems are closest to each other.

- Public sentiment strongly favored removing the Bowker Overpass and providing new or refurbished at-grade connections between Storrow Drive and the Massachusetts Turnpike.

A revised work program incorporated a number of Bowker-related analyses into the original study.

## Goals and Objectives

This study has four main goals that were developed through previous study efforts and the associated public process:

- Reduce traffic within the study area on the arterials and local streets
- Improve highway connections between Back Bay and crucial locations to the east, including but not limited to the Seaport District and Logan Airport
- Improve regional highway connections to the LMA without having an impact on local roads
- Determine locations to reconstruct parkways and related roadway elements to lower capacity standards

Practical objectives for this study were developed to support the four goals:

- Identify locations on I-90 in Boston where the addition of an eastbound on-ramp or westbound off-ramp would be feasible with respect to design and highway operations
- Estimate the traffic benefits of the feasible new ramps with regard to both reducing travel times between selected origins and destinations and reducing traffic on surface streets
- Evaluate potential negative impacts of new ramps with respect to pedestrian safety, neighborhood character, and environmental justice
- Consider possible modifications of roadway and intersection configurations that would eliminate the Bowker Overpass
- Present a broader picture of possible project elements, along with their positive and negative impacts

## Project study area

The Massachusetts Turnpike Extension is the central feature crossing from west to east and is the primary focus of this study. A half-mile buffer on either side of the Massachusetts Turnpike Extension was defined as the area in which analyses were performed.

All of the Massachusetts Turnpike Extension mainline segments and ramps were analyzed, along with arterial streets and associated intersections within the decribed

study area. Details of demographic areas and traffic analysis locations are presented graphically in subsequent chapters.

## Project Evaluation Criteria

Implementing any of the alternatives proposed in this study could have significant, far-reaching effects. Moreover, an impact that is positive as measured by one criterion might be negative with respect to a different criterion. A major challenge in this study is balancing the disparate impacts of potential alternatives.

The criteria are closely related to the quantitative and qualitative measurements with which each alternative was evaluated. The numerous possible impacts that could be associated with an alternative were organized into nine major groups:

- Traffic Operations
- Motorized Circulation and Access
- Transit Circulation and Access
- Nonmotorized Circulation and Access
- Safety
- Neighborhood Impacts
- Environmental Impacts
- Business Considerations
- Cost

## Public participation process

A Working Group representing state, regional, and local transportation planners, land use planners, and operating agencies was convened for this project. Working Group members included:

- Massachusetts Department of Transportation
- Boston Transportation Department
- Boston Redevelopment Authority
- Central Transportation Planning Staff
- Metropolitan Area Planning Council

The public at large was represented in the planning process by the Study Advisory Group (SAG). The group was composed of several dozen government, institutional, and neighborhood-based stakeholders, including:

Governmental Stakeholders and Organizations:

- The five Working Group organizations

- Massachusetts state representatives and senators
- City of Boston
- Boston City Council members
- City of Cambridge
- Town of Brookline
- Massachusetts Department of Conservation and Recreation
- Massachusetts Bay Transportation Authority
- Massachusetts Port Authority

Other Stakeholder Organizations:

- A Better City
- Allston Brighton Community Development Corporation
- Asian American Civic Association
- Asian Community Development Corporation
- Audubon Circle Neighborhood Association
- Back Bay Association
- Bay Village Neighborhood Association
- Beacon Hill Civic Association
- Blackstone Franklin Square Neighborhood Association
- Boston Red Sox
- Boston University
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- Neighborhood Association of the Back Bay
- Newbury Street League
- Old Dover Neighborhood Association
- St. Botolph Neighborhood Association
- Storrow Drive Advisory Committee
- The Chinatown Coalition
- Washington Gateway Main Street
- Worcester Square Neighborhood Association

## Public Informational Meetings

Informational meetings were held when key milestones in the project had been reached in order to give the public an opportunity to provide suggestions.

## Massachusetts Turnpike Back Bay Ramp Alternatives

At the beginning stages of the study process to develop a new ramp, seven ramp alternatives were partially developed based on previous studies. The initial screening provided four alternatives that were selected to be further developed and evaluated:

- Back Bay Alternative 1: New Westbound Off-Ramp to Berkeley Street
- Back Bay Alternative 2: New Westbound Off-Ramp to Trinity Place/Stuart Street
- Back Bay Alternative 3: New Westbound Off-Ramp to Brookline Avenue
- Back Bay Alternative 4: New Eastbound On-Ramp from the Bowker Overpass

A summary of each alternative's benefits and issues/impacts is provided in Chapter 10, Table 10-1.

## Bowker Overpass Alternatives

Four alternatives were "sketched" out in response to many organizations that had shown interest in altering or removing the Bowker Overpass. These preliminary alternatives have been further refined to meet this study's goals. The four final Bowker Overpass alternatives are:

- Bowker Overpass Alternative 1: Bowker Overpass Removed
- Bowker Overpass Alternative 2: Bowker Overpass At-Grade
- Bowker Overpass Alternative 3: New Regional Access
- Bowker Overpass Alternative 4: New Regional and Local Access

A summary of each alternative's benefits and issues/impacts is provided in Chapter 10, Table 10-2.

## Screening Evaluation

The Back Bay Ramp and Bowker Overpass alternatives were compared to the No-Build scenario to assess their relative benefits and drawbacks. The alternatives were screened according to nine criterions:

- Traffic
- Motorized circulation and access
- Transit circulation and access
- Non-motorized circulation and access
- Safety

- Neighborhood impacts
- Environmental impacts
- Business considerations
- Cost

Overall, none of the Back Bay Ramp alternatives or the Bowker Overpass alternatives ranked positively. Only Back Bay Ramp Alternatives 1 and 3 had an overall rank of neutral. The rest of the alternatives had overall ranks of negative.

A summary of each alternative's evaluation is provided in Chapter 10, Table 10-3.

## Conclusions

As this study proceeded from initial public meetings to this final report, staff reached a number of conclusions by carefully reviewing the evaluation results, and considering the communities' input at public meetings and their written comments:

- Based on the study and evaluation of the Back Bay Ramp and Bowker Overpass alternatives, there is no single alternative that is recommended for further study or implementation. As the evaluation indicates, there are no alternatives, as presently developed and evaluated, that meet the study's goals and objectives. The estimated construction cost of the alternatives cannot be justified, since no one alternative for the Back Bay Ramps or the Bowker Overpass satisfies the goals of the study.
- None of the proposed Bowker Overpass alternatives provided a suitable direct replacement to serve the regional traffic issue and meet the study's goals and objectives. Alternative 2, which replaces the overpass with at-grade roadways, creates major traffic issues and significantly affects the park's open space. The other alternatives create traffic diversions to other roadways and neighborhoods—in some cases, with a significant construction cost.
- Analysis of a recent MassDOT project at the Allston I-90 Interchange was not part of this study. Any future Back Bay Ramps or Bowker Overpass studies should include the proposed realignment of that interchange and potential impacts to the Massachusetts Turnpike and Bowker Overpass.

# Chapter 1—Background, Goals, Study Area, and Organization

## 1.1 INTRODUCTION

This report summarizes the findings of the Massachusetts Turnpike Boston Ramps and Bowker Overpass Study. The Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP) sponsored this study.

Historically, the responsibility for studying key highway and arterial systems was divided between several state organizations, including the Massachusetts Turnpike Authority, the Department of Conservation and Recreation, and the Massachusetts Highway Department. The creation of MassDOT in 2009, which consolidated state transportation agencies and functions, allowed MassDOT to study and develop proposed improvements to all of the interconnected roadway systems in the study area (see Section 1.3 for a description of the study area). This work was undertaken with the cooperation of key stakeholders in the city of Boston and of the public at large.

## 1.2 BACKGROUND

### 1.2.1 The Massachusetts Turnpike Extension Is Built

In 1965, the Massachusetts Turnpike Authority opened a tolled extension of Interstate 90 (I-90) between the Route 128 circumferential highway in Weston and I-93 near South Station. Figure 1-1 shows an early depiction of the proposed Bowker Overpass over I-90. This urban freeway, referred to as the Massachusetts Turnpike Extension, was constructed at considerable expense, and was designed so that all users would need to pay a toll when using this section of the Massachusetts Turnpike.

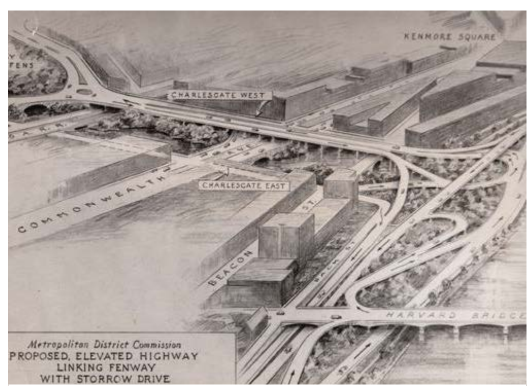

Figure 1-1 – Illustration shows the proposed 1952 plan for an elevated highway that would link the Fenway Neighborhood and Storrow Drive (Bowker Overpass). *Metropolitan District Commission/Boston Globe Archives*

The requirement that there would be "no free ride" had an important consequence. The only location with sufficient land for a set of toll plazas was in Allston, and all users entering or exiting the Massachusetts Turnpike Extension in the Back Bay area or at I-93 would need to pass through the Allston toll plaza. The Massachusetts Turnpike Extension was built with all of the on-ramps in the downtown area accessing the westbound Turnpike (toward the Allston plaza), and all of the downtown off-ramps accessing the eastbound Turnpike; only

vehicles that already had paid a toll in Allston were allowed to exit. This ramp configuration was adequate as long as the easternmost source of traffic was I-93. The traffic between I-93 and the Back Bay could use Storrow Drive to travel to or from the north, and Berkeley and Herald streets to travel to or from the south.

Figure 1-2 is a 1963 photo showing the view looking east from Charlesgate; in the lower-right corner, a newly completed bridge support for the future Bowker Overpass can be seen.

Figure 1-2 1963 photo showing the view looking east from Charlesgate

### 1.2.2 The CA/T Is Planned

As the Central Artery/Third Harbor Tunnel (CA/T) was being designed, it became clear that the Turnpike Extension would need to serve an expanded set of locations to the east—notably the Seaport District, Logan International Airport, East Boston, and nearby North Shore areas that were being transformed.

In 1997, the management of the Massachusetts Turnpike Extension and the highways being reconstructed as part of the CA/T project was merged, by legislation, into a new entity called the Metropolitan Highway System (MHS), which was under the jurisdiction of the Turnpike Authority. The MHS received toll revenue streams from the Turnpike Extension, Sumner Tunnel, and Ted Williams Tunnel (opened in 1995).With revenues from tolls and other funding sources, the MHS assumed responsibility for completing the CA/T.

### 1.2.3 The Need for Better Connections Increases

The Ted Williams Tunnel was not connected to the Extension for another eight years—it required some of the most challenging construction in the CA/T project. In 1997, anticipating the need to use I-90 to connect Back Bay with new developments to the east, the Turnpike Authority released the Massachusetts Turnpike Boston Extension Ramps Feasibility Study (the Feasibility Study). The Feasibility Study evaluated various combinations of new eastbound entrances and westbound exits of the Turnpike between Chinatown and Kenmore Square. Because of the costs of construction and impacts of introducing new ramps into the fabric of existing neighborhoods, none of the alternatives was considered feasible.

At the time of the Feasibility Study, a convention center in the Seaport District was only under consideration. With the subsequent enactment of required enabling legislation, the new convention center became possible, and the Boston Convention and Exhibition Center (BCEC) opened in 2004. Because many of the hotel rooms required for large conventions and trade shows were still located in the Back Bay, near the Hynes Convention Center, which is smaller than the BCEC, the economic vitality of the Seaport District and of the Back Bay neighborhoods became interdependent. Better connections between the Back Bay and points east were again on the planning agenda.

Given the findings of the Feasibility Study, lower-cost and less-intrusive solutions were sought. A tolled U-turn was constructed at the Allston toll plaza to allow Back Bay vehicles and/or westbound Turnpike vehicles to reverse direction to reach destinations in the Seaport District or Logan Airport. However, using this feature added at least 3.4 miles to any trip from the Back Bay to either of these destinations. The possibility of extending the Silver Line tunnel from South Station to the Boylston Green Line station was also studied, but was not considered for implementation because of high construction costs.

### 1.2.4 The Origin of This Study

The subject of new ramps and better access to the urban districts cited above was revisited by MassDOT. MPO staff were retained to perform modeling and to provide other technical support. Initially, the analysis focused on identifying access points for entering the eastbound Massachusetts Turnpike and for exiting the westbound Turnpike at points convenient to Back Bay locations. The scope of the project was later expanded to address regional connectivity issues, such as access to the Turnpike from the Longwood Medical and Academic Area (LMA). The initial results of traffic modeling for the study area were presented at a public meeting at the Boston Public Library. At the public meeting, it became evident that the vicinity of the Bowker Overpass would be an important nexus in the next phase of MassDOT's study. Several factors pointed to this conclusion:

- By including the LMA in the study area, access to the Massachusetts Turnpike near Kenmore Square would become a more important consideration.
- The Bowker Overpass, built at the same time as the Boston Extension, needed significant refurbishment, making reconsideration of its design and function timely.
- Adding new ramps to access the Massachusetts Turnpike would allow a reevaluation of the relationship between traffic on Storrow Drive and traffic on the Massachusetts Turnpike, and the Bowker Overpass and ramps are located where these two roadway systems are closest to each other.

- Public sentiment strongly favored removing the Bowker Overpass and providing new or refurbished at-grade connections between Storrow Drive and the Massachusetts Turnpike.

A revised work program incorporated a number of Bowker-related analyses into the original study.

### 1.2.5 Goals

Previous studies of Massachusetts Turnpike access and egress issues demonstrated that recommendations from this study should address the following four broad goals:

- Reduce traffic within the study area on the arterials and local streets
- Improve highway connections between Back Bay and crucial locations to the east, including but not limited to the Seaport District and Logan Airport
- Improve regional highway connections to the Longwood Medical Area (LMA) without having an impact on local roads
- Determine locations to reconstruct parkways and related roadway elements to lower capacity standards

These goals are presented in roughly the order of importance. The need to connect the Back Bay with the Seaport District and Logan Airport was anticipated well before development in the Seaport District accelerated. Increased travel demand for the Seaport District and Logan Airport has contributed to traffic congestion on local streets and to slow travel times for workers and visitors in these areas. The inability to use Massachusetts Turnpike to access the LMA efficiently from any direction was appropriately flagged as a related traffic issue. Finally, the use of parkways as urban express highways has been an ongoing concern, and revisiting this in the context of opportunities to reconfigure the Massachusetts Turnpike ramps is now a major goal.

### 1.2.6 Objectives

This study has a number of practical objectives that support the four goals:

- Identify locations on the Massachusetts Turnpike in Boston where the addition of an eastbound on-ramp or westbound off-ramp would be feasible with respect to design and highway operations
- Estimate the traffic benefits of the feasible new ramps with regard to both reducing travel times between selected origins and destinations and reducing traffic on surface streets
- Evaluate the potential negative impacts of new ramps with respect to pedestrian safety, neighborhood character, and environmental justice populations

- Consider possible modifications of roadway and intersection configurations that would eliminate the Bowker Overpass
- Present a broader picture of possible project elements, along with their positive and negative impacts

All of the study objectives relate to the four goals. However, the goals are not complementary. For example, it might be possible to further an individual goal which best serves the public interest and, in the process, compromise another goal to some degree. This becomes a balancing act between what is necessary for a transportation project and what is in the best interests of the public it serves.

## 1.3 PROJECT STUDY AREA

The analyses in this report were conducted for locations within the project study area, shown in Figure 1-3. The Massachusetts Turnpike Extension is the central feature crossing Figure 1-3 from west to east. A half-mile buffer on either side of the Massachusetts Turnpike Extension was defined as the area in which environmental justice analyses were performed.

All of the Massachusetts Turnpike Extension mainline segments and ramps that are shown in Figure 1-3 were analyzed. Most of the arterial streets and associated intersections analyzed also appear in Figure 1-3, but several at more distant locations were also studied. Details of demographic areas and traffic analysis locations are presented graphically in subsequent chapters.


**FIGURE 1-3**
**Massachusetts Turnpike Boston Ramps and Bowker Overpass Study Area**

## 1.4 PROJECT EVALUATION CRITERIA

Implementing any of the alternatives proposed in this study could have significant, far-reaching effects. Moreover, an impact that is positive as measured by one criterion might be negative with respect to a different criterion. A major challenge in this study is balancing the disparate impacts of potential alternatives.

The criteria are closely related to the quantitative and qualitative measurements with which each alternative was evaluated. The numerous possible impacts that could be associated with an alternative were organized into nine major groups, as shown in Table 1-1. Each of the nine criteria has several associated measurements, which are listed and described in the table.

**TABLE 1-1**
**Project Evaluation Criteria**

| Evaluation Criteria | Measurements |
|---|---|
| Traffic Operations | • *Queues, delays, and level of service* |
| Motorized Circulation and Access | • *Vehicle route connectivity, directness, and continuity*<br>• *Travel time* |
| Transit Circulation and Access | • *Changes in access for transit passengers*<br>• *Physical impacts to proposed transit* |
| Nonmotorized Circulation and Access | • *Bicycle and pedestrian access*<br>• *Pedestrian delay* |
| Safety | • *Vehicle crashes*<br>• *Changes in bicycle and pedestrian route separation*<br>• *Changes in emergency-vehicle access*<br>• *Highway ramp level of service and geometrics* |
| Neighborhood Impacts | • *Noise and traffic diversions*<br>• *Neighborhood cohesion and aesthetics* |
| Environmental Impacts | • *Air quality*<br>• *Parks, open space, and wetlands*<br>• *Historic districts and sites*<br>• *Hazardous-material sites* |
| Business Considerations | • *Truck circulation and access*<br>• *Parking impacts*<br>• *Access to existing and future development sites*<br>• *Physical impacts to development sites and air-rights locations* |
| Cost | • *Total construction cost* |

# 1.5 PUBLIC PARTICIPATION PROCESS

## 1.5.1 Project Working Group

A Working Group representing state, regional, and local transportation planners, land use planners, and operating agencies was convened for this project. Working Group members included:

- Massachusetts Department of Transportation
- Boston Transportation Department
- Boston Redevelopment Authority
- Central Transportation Planning Staff
- Metropolitan Area Planning Council

## 1.5.2 Study Advisory Group

The public at large was represented in the planning process by the Study Advisory Group (SAG). The group was composed of several dozen government, institutional, and neighborhood-based stakeholders, including:

Governmental Stakeholders and Organizations:

- The five Working Group organizations
- Massachusetts state representatives and senators
- City of Boston
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- Newbury Street League
- Old Dover Neighborhood Association
- St. Botolph Neighborhood Association
- Storrow Drive Advisory Committee
- The Chinatown Coalition
- Washington Gateway Main Street
- Worcester Square Neighborhood Association

### 1.5.3 Public Informational Meetings

Informational meetings were held when key milestones in the project had been reached in order to give the public with an opportunity to provide suggestions. Summaries and presentation materials of all of the study's meetings are in Appendix A.

# Chapter 2—Existing Conditions: Massachusetts Turnpike Ramps

## 2.1 INTRODUCTION

This chapter presents an analysis of existing transportation conditions for the study area. The traffic conditions for a typical workday were analyzed, with an emphasis on the peak AM and PM commuting hours. The analysis included traffic conditions, crash analyses, and crash patterns for the Massachusetts Turnpike and associated roadways in the study area (shown in Figure 2-1), as well as reviews of transit services, environmental conditions, and land uses.

## 2.2 TRAFFIC CONDITIONS

Developing a basic knowledge of current traffic conditions fosters an understanding of where congestion occurs as the Massachusetts Turnpike is currently configured and where it likely will occur in the future. The traffic analysis for this study was based on traffic count data collected within the study area. The Massachusetts Department of Transportation's Office of Transportation Planning (OTP) obtained traffic data for the Massachusetts Turnpike between the Allston toll plaza and the Ted Williams Tunnel, and for specific intersections throughout the study area. The traffic volumes used in this analysis are presented in Section 2.2.1.

Section 2.2.2 presents the analysis of the freeway and merge/diverge conditions using these traffic volumes. In addition to the Massachusetts Turnpike, other key intersections and arterials throughout the study area were analyzed (see Sections 2.2.3 and 2.2.4).

### 2.2.1 Traffic Volumes in 2010

The segment of the Massachusetts Turnpike (I-90) between the Allston toll plaza and the Ted Williams Tunnel, in South Boston, is approximately 4.5 miles in length. The primary focus of this study is the Massachusetts Turnpike in the vicinity of the Back Bay and Fenway neighborhoods. This segment of the Turnpike carries between six and eight lanes of traffic in both directions. West of the Prudential Tunnel, the roadway has eight 11.5-foot lanes (four in each direction, separated by a six-foot-wide median). The left and right shoulders are each two feet wide. East of the Prudential Tunnel, the roadway has six 12-foot lanes, four-foot-wide right shoulders, and three-foot-wide left shoulders, with a six-foot-wide median. The roadway is below grade from Commonwealth Avenue to the east side of the Ted Williams Tunnel, in East Boston, with eight bridges crossing over the roadway west of the Prudential Tunnel and eight bridges crossing over the roadway between the Prudential Tunnel and the I-93 interchange. The Massachusetts Turnpike

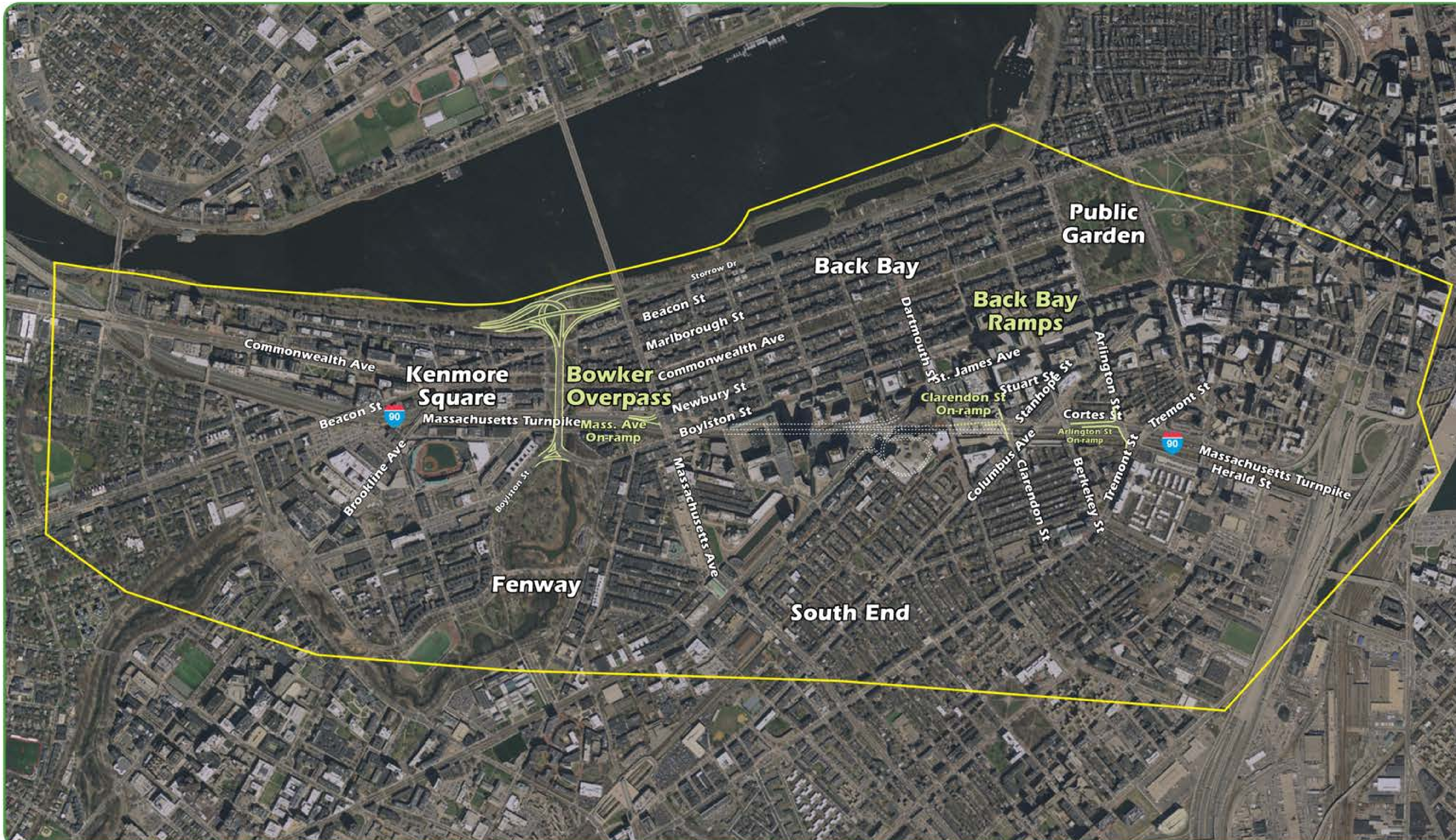



**FIGURE 2-1**
**Massachusetts Turnpike Boston Ramps and Bowker Overpass Study Area**

is in a tunnel between the I-93 interchange and the portal in East Boston. There is a section (approximately 875 feet) of the Turnpike in South Boston where the roadway is uncovered before it enters the Ted Williams Tunnel.

The Massachusetts Turnpike is a principal trucking route through the city of Boston. However, trucks carrying hazardous cargo are not permitted on the Turnpike east of the Allston toll plaza because there are many tunnels in that portion of the Turnpike and they are prohibited from traveling through tunnels.

South of the roadway, the Massachusetts Bay Transportation Authority (MBTA) Framingham/Worcester commuter rail line parallels the Turnpike between the Allston toll plaza and the Prudential Tunnel. MBTA express buses travel on the Turnpike during peak periods between the Allston toll plaza and the I-93 interchange, as well as in the Ted Williams Tunnel.

Traffic count data for the Massachusetts Turnpike were obtained using automatic traffic recorders (ATRs) and toll revenue counts. Automatic traffic recorders calculate hourly traffic volumes over the course of several weekdays. This study uses counts taken in 2007 and 2008 at various times of the year. To ensure consistent counts, adjustment factors were applied to compensate for seasonal variations and growth to 2010 in the traffic volumes. Table 2-1 lists the locations of the ATRs that were used for this study.

**TABLE 2-1**
**Massachusetts Turnpike: Automated-Traffic-Recorder Locations**

1. I-90 EB exit ramps at Prudential Center
2. I-90 EB mainline just before Exit 24 (I-93)
3. I-90 EB exit ramps at I-93 (Exit 24), including the South Station ramp
4. I-90 EB exit ramp for South Boston
5. I-90 EB on-ramp from I-93 NB
6. I-90 EB mainline just before the South Boston on-ramp
7. I-90 EB on-ramp from South Boston
8. I-90 EB on-ramp from HOV lane
9. I-90 EB off-ramp to Logan Airport
10. I-90 EB mainline just after the Ted Williams Tunnel
11. I-90 WB on-ramp from South Boston
12. I-90 WB on-ramp from I-93 NB
13. I-90 WB on-ramp from I-93 SB
14. I-90 WB mainline just west of Exit 20 (I-93)
15. I-90 WB Arlington Street on-ramp
16. I-90 WB Clarendon Street on-ramp
17. I-90 WB Copley Square on-ramp
18. I-90 WB Massachusetts Avenue on-ramp

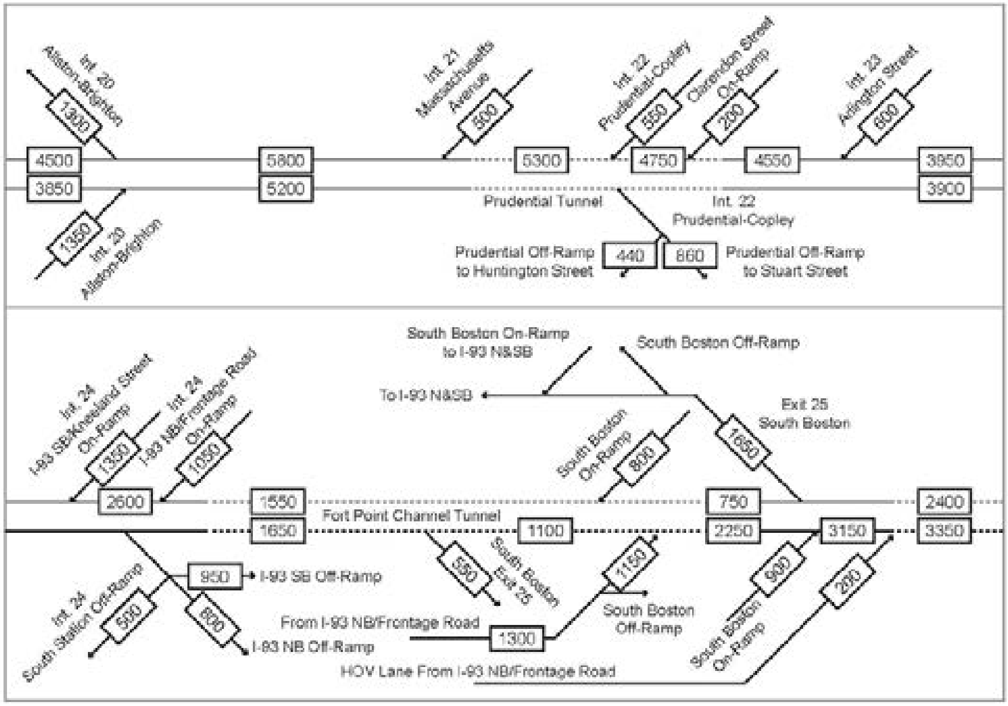
In November of 2008, in addition to ATR counts, revenue toll counts were obtained for the interchanges in Allston, the Ted Williams Tunnel, and the Sumner Tunnel over the course of five weekdays, as shown in Table 2-2. Since these counts represent every vehicle that travels past a tollbooth, axle adjustments were not necessary, but the seasonal adjustment was necessary, and was applied before the counts were finalized.

**TABLE 2-2**
**Revenue Toll Counts Collected on Five Weekdays on the Massachusetts Turnpike**

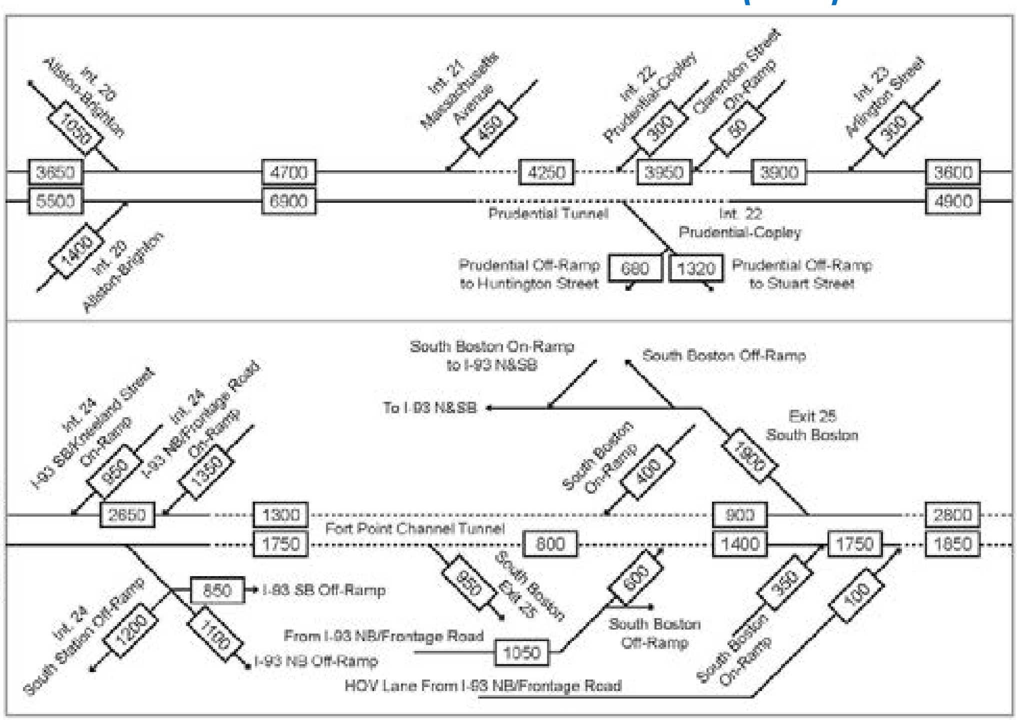
1. I-90 EB mainline at Allston
2. I-90 EB on ramp from Cambridge Street
3. I-90 WB off-ramp to Cambridge Street (Exit 20)
4. I-90 U-turn at Allston toll plaza
5. I-90WB mainline at the Ted Williams Tunnel
6. I-90 WB on-ramp from Logan Airport
7. Sumner Tunnel

With two sets of traffic counting methods complete, balanced-volume diagrams were created for the Massachusetts Turnpike. These diagrams include all entry and exit ramps to produce a complete picture of AM (7:00 AM–9:00 AM) and PM (4:00 PM–6:00 PM) peak hours use for the Turnpike. Figures 2-2 and 2-3 show the AM- and PM-peak-hour balanced volumes, respectively, of traffic on the Turnpike between the Allston toll plaza and Ted Williams Tunnel.

## Figure 2-2
## AM-Peak-Hour Volumes: Massachusetts Turnpike between the Allston Tolls and Ted Williams Tunnel (2010)




## Figure 2-3
## PM-Peak-Hour Volumes: Massachusetts Turnpike between the Allston Tolls and Ted Williams Tunnel (2010)



### 2.2.2 Interchange and Freeway Analysis

The balanced-volume counts were used to perform interchange and freeway analyses using the 2010 Highway Capacity Software™ (HCS). HCS can be used to calculate the traffic density and computed speeds along mainlines and at freeway merges and diverges. These calculations are used for evaluating the performance of a transportation network using the level of service (LOS) as the metric. LOS is graded from A through F, with LOS A representing free-flow conditions and LOS F representing unstable or failing traffic conditions. The remaining grades, B through E, represent gradations of LOS. Table 2-3 provides the LOS criteria for freeway segments and Table 2-4 provides the LOS for ramp merges and diverges. MassDOT considers LOS A, B, C, and D acceptable for urban areas. LOS E and F are considered unacceptable and indicate the need for improvement.

**TABLE 2-3**
**Level of Service Criteria for**
**Freeway Merge and Diverge Segments (2010)**

| Level of Service | Passenger Cars/Mile/Lane (Density) |
|---|---|
| A | ≤ 10 |
| B | > 10-20 |
| C | > 20-28 |
| D | > 28-35 |
| E | > 35 |
| F | Demand exceeds capacity |

**TABLE 2-4**
**Level of Service Criteria for**
**Freeway Ramp Merge and Diverge Segments (2010)**

| Level of Service | Passenger Cars/Mile/Lane (Density) |
|---|---|
| A | ≤ 11 |
| B | > 11-18 |
| C | > 18-26 |
| D | > 26-35 |
| E | > 35-45 |
| F | > 45 |

The LOS for each ramp's merge/diverge areas, as well as for several mainline locations on the Massachusetts Turnpike between the Allston toll plaza and the Ted Williams Tunnel, was calculated. Figure 2-4 shows the LOS results for the AM peak hour; Figure 2-5 shows the LOS results for the PM peak hour. Letters shaded in green represent uncongested intersections, at LOS A, B, or C; orange represents somewhat congested intersections, at LOS D; and red represents an unacceptable LOS of E or F.

**Figure 2-4**
**AM-Peak-Hour Level of Service: Massachusetts Turnpike between the Allston Toll Plaza and the Ted Williams Tunnel (2010)**

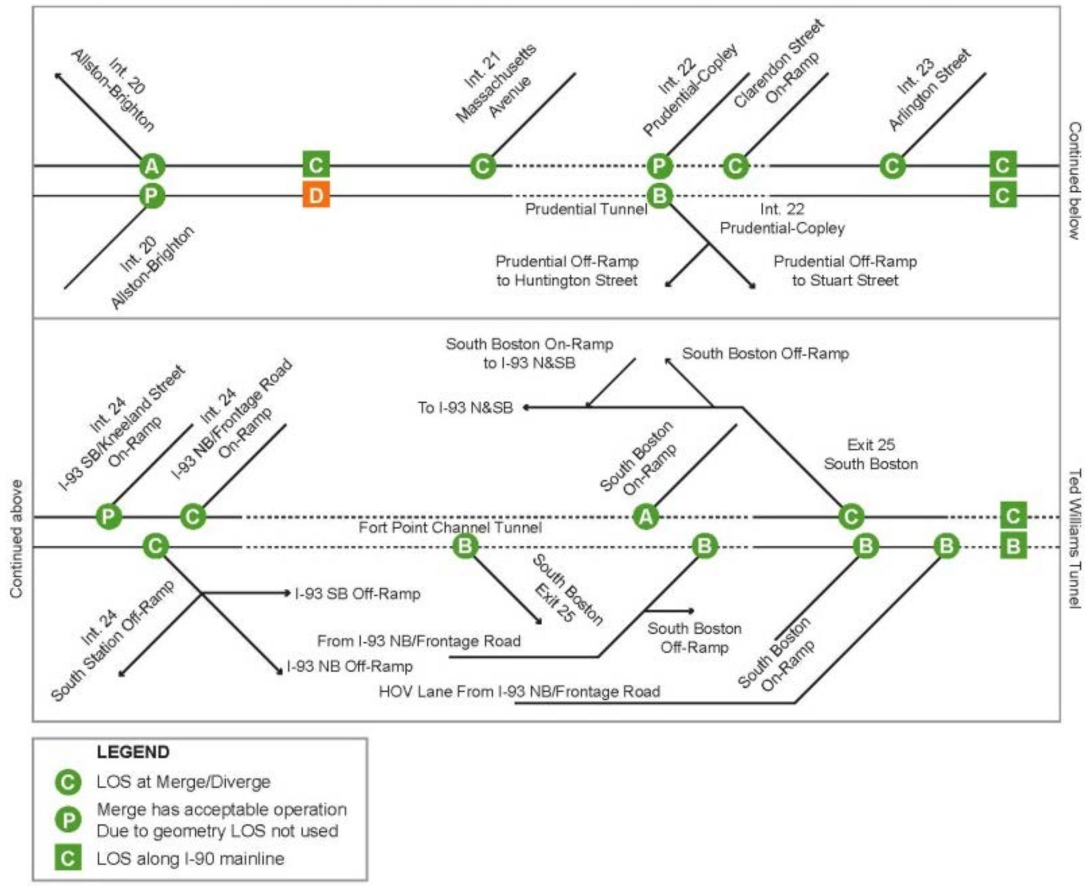
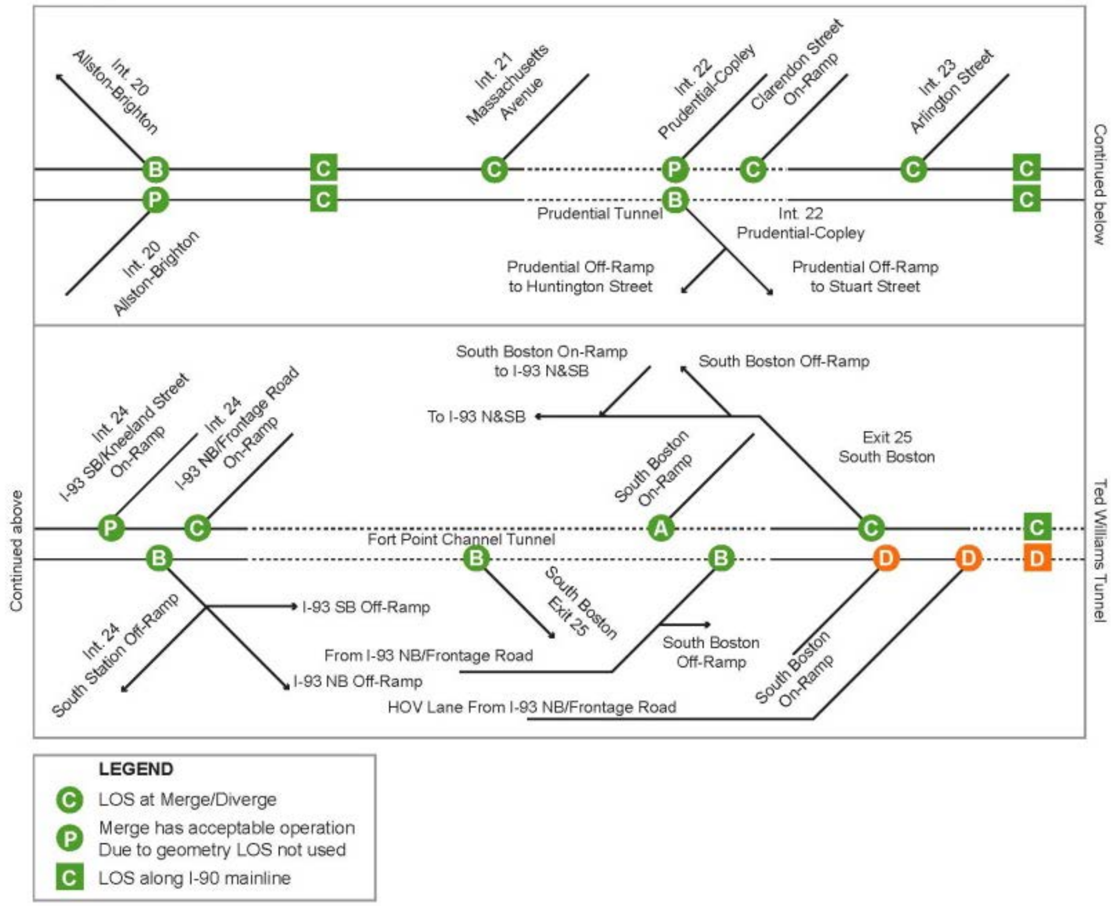


**Figure 2-5**
**PM-Peak-Hour Level of Service: Massachusetts Turnpike between the Allston Toll Plaza and the Ted Williams Tunnel (2010)**




## *Merge/Diverge Analysis*

The Highway Capacity Software cannot be used for major merge areas, such as places where an on-ramp merges with a freeway and forms an additional lane on the mainline. This situation occurs at the on-ramp from Cambridge Street to I-90 EB at the Allston I-90 interchange. For this location, the Highway Capacity Manual must be used to determine if a roadway has the capacity to handle the volume for each leg (the mainline before the merge, the mainline after the merge, and the ramp). As long as all three legs show percentages of less than 100 percent, the highway is considered to have enough capacity to handle the volumes and the merge is considered acceptable.

Table 2-5 shows the volume-to-capacity ratio of the major merge from Cambridge Street onto I-90 eastbound. The volume-to-capacity ratios for each leg were all less than 100 percent, with the AM peak hour just over 75 percent and the PM peak hour closer to a 50 percent volume-to-capacity ratio. This indicates that the highway has the

capacity to handle traffic entering from the Cambridge Street on-ramp. All of the analysis was based on a free-flow speed of 55 mph.

**TABLE 2-5**
**Analysis of Major Merge Area in Allston (2010)**

| Location | Volume (veh/hour) | Capacity (veh/hour) | Volume-to-Capacity Ratio (percent of capacity used) |
|---|---|---|---|
| **I-90 EB Allston-Brighton On-Ramp (Int. 20) - AM Peak Hour** | | | |
| Leg 1: I-90 EB before merge | 5,500 | 7,050 | 78.01% |
| Leg 2: On-ramp | 1,400 | 4,700 | 29.79% |
| Leg 3: I-90 EB after merge | 6,900 | 9,400 | 71.49% |
| **I-90 EB Allston-Brighton On-Ramp (Int. 20) - PM Peak Hour** | | | |
| Leg 1: I-90 EB before merge | 5,500 | 7,050 | 78.01% |
| Leg 2: On-ramp | 1,400 | 4,700 | 29.79% |
| Leg 3: I-90 EB after merge | 6,900 | 9,400 | 71.49% |

Table 2-6 shows the HCS results for the ramp merges and diverges.

**TABLE 2-6**
**Level of Service on Massachusetts Turnpike Ramp Merges and Diverges (2010)**

| Location | Computed Speeds (mph) | Passenger Cars/Mile/Lane | LOS |
|---|---|---|---|
| AM PEAK PERIOD | | | |
| I-90 EB Int. 20 Allston-Brighton | | | |
| I-90 EB Int. 22 Prudential-Copley off-ramp* | 47.1 | 19.1 | B |
| I-90 EB Int.24 I-93/South Station off-ramp* | 49.1 | 26.5 | C |
| I-90 EB Exit 25 South Boston off-ramp | 48.3 | 17.6 | B |
| I-90 EB I-93 NB on-ramp | 51 | 14 | B |
| I-90 EB South Boston on-ramp | 51 | 17.5 | B |
| I-90 EB HOV from I-93 on-ramp | 51 | 16.9 | B |
| I-90 WB Exit 25 I-93/South Boston off-ramp | 47.2 | 25 | C |
| I-90 WB South Boston on-ramp | 51 | 9.3 | A |
| I-90 WB Int. 24 I-93 NB on-ramp | 50 | 24.1 | C |
| I-90 WB Int. 24 I-93 SB on-ramp | | | |
| I-90 WB Int. 23 Arlington Street on-ramp | 57 | 23 | C |
| I-90 WB Clarendon Street on-ramp | 57 | 22.5 | C |
| I-90 WB Int. 22 Prudential-Copley on-ramp | | | |
| I-90 WB Int. 21 Massachusetts Avenue on-ramp | 57 | 21.2 | C |
| I-90 WB Int. 20 Allston-Brighton* | 51.6 | 8.9 | A |

* Special HCM analysis used for off-ramps where one or more mainline lanes exited at the off-ramp. Only the vehicle density needs to be calculated to determine LOS.

**TABLE 2-6 cont.**
**Level of Service on Massachusetts Turnpike Ramp Merges and Diverges (2010)**

| Location | Computed Speeds (mph) | Passenger Cars/Mile/Lane | LOS |
|---|---|---|---|
| PM PEAK PERIOD | | | |
| I-90 EB Int. 20 Allston-Brighton | | | |
| I-90 EB Int. 22 Prudential-Copley off-ramp* | 47.9 | 10.8 | B |
| I-90 EB Int.24 I-93/South Station off-ramp* | 50.2 | 17.7 | B |
| I-90 EB Exit 25 South Boston off-ramp | 48.8 | 16.8 | B |
| I-90 EB I-93 NB on-ramp | 51 | 18.9 | B |
| I-90 EB South Boston on-ramp | 50 | 28.2 | D |
| I-90 EB HOV from I-93 on-ramp | 50 | 28.6 | D |
| I-90 WB Exit 25 I-93/South Boston off-ramp | 47.5 | 21.5 | C |
| I-90 WB South Boston on-ramp | 52 | 7.8 | A |
| I-90 WB Int. 24 I-93 NB on-ramp | 50 | 24.1 | C |
| I-90 WB Int. 24 I-93 SB on-ramp | | | |
| I-90 WB Int. 23 Arlington Street on-ramp | 56 | 26.8 | C |
| I-90 WB Clarendon Street on-ramp | 56 | 26.6 | C |
| I-90 WB Int. 22 Prudential-Copley on-ramp | | | |
| I-90 WB Int. 21 Massachusetts Avenue on-ramp | 57 | 24.9 | C |
| I-90 WB Int. 20 Allston-Brighton* | 51.3 | 13.0 | B |

* Special HCM analysis used for off-ramps where one or more mainline lanes exited at the off-ramp. Only the vehicle density needs to be calculated to determine LOS.

### *Freeway Analysis*

The 2010 traffic volumes were entered into the HCS software to calculate the LOS for locations on the portions of I-90 and I-93 that are within the study area. Table 2-7 presents the results.

**TABLE 2-7**
**Level of Service of Massachusetts Turnpike Mainline Locations (2010)**

| Location | Computed Speeds (mph) | Passenger Cars/Mile/ Lane | LOS |
|---|---|---|---|
| AM PEAK PERIOD | | | |
| I-90 EB between Prudential Tunnel and Allston toll plaza (Int. 20) | 63.3 | 27.5 | D |
| I-90 WB between Prudential Tunnel and Allston toll plaza (Int. 20) | 65.0 | 18.3 | C |
| I-90 EB between Prudential Tunnel and I-93 exit (Int. 24) | 64.1 | 25.7 | C |
| I-90 WB between Prudential Tunnel and I-93 exit (Int. 24) | 65.0 | 18.6 | C |
| I-90 EB in Ted Williams Tunnel | 55.0 | 17.0 | B |
| I-90 WB in Ted Williams Tunnel | 55.0 | 25.7 | C |
| PM PEAK PERIOD | | | |
| I-90 EB between Prudential Tunnel and Allston toll plaza (Int. 20) | 65.0 | 20.2 | C |
| I-90 WB between Prudential Tunnel and Allston toll plaza (Int. 20) | 64.9 | 22.5 | C |
| I-90 EB between Prudential Tunnel and I-93 exit (Int. 24) | 65.0 | 20.2 | C |
| I-90 WB between Prudential Tunnel and I-93 exit (Int. 24) | 65.0 | 20.5 | C |
| I-90 EB in Ted Williams Tunnel | 55.0 | 30.8 | D |
| I-90 WB in Ted Williams Tunnel | 55.0 | 22 | C |

### 2.2.3 Arterial Analysis

Several arterials were included in this analysis to represent the key connectors between the Longwood Medical Area/Fenway/Back Bay area, the South Boston Waterfront, and Logan Airport. The selected arterials include bridges crossing the Charles River, tunnels connecting to Logan Airport, and limited-access roadways that parallel the Massachusetts Turnpike. Table 2-8 lists these key arterials.

**TABLE 2-8**
**Key Arterials (2010)**

| |
|---|
| 1. Boston University Bridge |
| 2. Harvard Bridge |
| 3. Longfellow Bridge |
| 4. Memorial Drive |
| 5. Storrow Drive |
| 6. Callahan Tunnel and Sumner Tunnel |
| 7. Zakim Bridge (Interstate 93) |

The HCS was used to determine the LOS based on vehicle density; the results are provided in Table 2-9. Figures 2-6 and 2-7 show the AM and PM peak-hour existing LOS for each key arterial within the study area.

During both the AM and PM peak hours, traffic conditions on the key arterials ranged from LOS A to LOS D. In the AM peak hour, Storrow Drive operated at LOS D or better, which is acceptable. The segment of Storrow Drive between the Longfellow Bridge and Leverett Circle had the highest traffic density of the three sections analyzed. The three key bridges over the Charles River that are accessible from Storrow Drive—Boston University, Harvard, and Longfellow—all operated at LOS C or better. The Callahan and Sumner tunnels also operated at LOS C, while the Zakim Bridge operated at LOS C or better.

In the PM peak hour, Storrow Drive operated slightly better overall than during the AM peak hour. The three key bridges off of Storrow Drive operated at LOS B or better. The Callahan and Sumner tunnels, as well as the Zakim Bridge, operated at LOS C or better.

**TABLE 2-9**
**Analysis of Key Arterials (2010)**

| Location | Direction | Computed Speeds (mph) | Passenger Cars/ Mile/Lane | LOS |
|---|---|---|---|---|
| AM PEAK PERIOD | | | | |
| Boston University Bridge (Route 2) | NB | 45.0 | 19.6 | C |
| | SB | 45.0 | 12.8 | B |
| Harvard Bridge (Route 2A) | NB | 45.0 | 11.0 | A |
| | SB | 45.0 | 19.0 | A |
| Longfellow Bridge (Route 3) | EB | 45.0 | 9.9 | A |
| | WB | 45.0 | 10.7 | A |
| Memorial Drive between Boston University Bridge and Harvard Bridge (Route 3) | EB | 45.0 | 23.3 | C |
| | WB | 45.0 | 12.3 | B |
| Memorial Drive between Harvard Bridge and Longfellow Bridge (Route 3) | EB | 45.0 | 23.2 | C |
| | WB | 45.0 | 12.4 | B |
| Storrow Drive between Harvard Bridge and Berkeley Street | EB | 45.0 | 28.1 | D |
| | WB | 55.0 | 20.0 | C |
| Storrow Drive between Berkeley Street and Longfellow Bridge (Route 28) | EB | 45.0 | 28.1 | D |
| | WB | 55.0 | 20.0 | C |
| Storrow Drive between Longfellow Bridge and Leverett Circle (Route 28) | EB | 45.0 | 18.5 | C |
| | WB | 44.7 | 33.6 | D |
| Callahan Tunnel | NB | 45.0 | 9.3 | A |
| Sumner Tunnel | SB | 45.0 | 19.1 | C |
| Zakim Bridge (Interstate 93) | NB | 65.0 | 15.9 | B |
| | SB | 64.9 | 22.6 | C |

**TABLE 2-9 cont.**
**Analysis of Key Arterials (2010)**

| Location | Direction | Computed Speeds (mph) | Passenger Cars/ Mile/Lane | LOS |
|---|---|---|---|---|
| PM PEAK PERIOD | | | | |
| Boston University Bridge (Route 2) | NB | 45.0 | 14.5 | B |
| | SB | 45.0 | 17.8 | B |
| Harvard Bridge (Route 2A) | NB | 45.0 | 13.9 | B |
| | SB | 45.0 | 11.7 | B |
| Longfellow Bridge (Route 3) | EB | 45.0 | 15.5 | B |
| | WB | 45.0 | 8.1 | A |
| Memorial Drive between Boston University Bridge and Harvard Bridge (Route 3) | EB | 45.0 | 12.1 | B |
| | WB | 45.0 | 14.6 | B |
| Memorial Drive between Harvard Bridge and Longfellow Bridge. (Route 3) | EB | 45.0 | 13.4 | B |
| | WB | 45.0 | 13.7 | B |
| Storrow Drive between Harvard Bridge and Berkeley Street | EB | 45.0 | 22.2 | C |
| | WB | 55.0 | 23.6 | C |
| Storrow Drive between Berkeley Street and Longfellow bridge (Route 28) | EB | 45.0 | 24.4 | C |
| | WB | 44.8 | 32.7 | D |
| Storrow Drive between Longfellow Bridge and Leverett Circle (Route 28) | EB | 45.0 | 19.5 | C |
| | WB | 45.0 | 29.6 | D |
| Callahan Tunnel | NB | 45.0 | 19.2 | C |
| Sumner Tunnel | SB | 45.0 | 16.8 | B |
| Zakim Bridge (Interstate 93) | NB | 65.0 | 22.3 | C |
| | SB | 65.0 | 17.6 | B |

## 2.2.4 Intersection Analysis

Table 2-10 lists the key signalized intersections that vehicles currently pass through when traveling between the Longwood Medical Area/Fenway/Back Bay area, the South Boston Waterfront, and Logan Airport. These intersections are all signalized and are located on major roadways.

**TABLE 2-10**
**Key Intersections: LMA, Fenway, Back Bay, South Boston Waterfront, and Logan Airport (2010)**

| | |
|---|---|
| 1. | Park Drive at Brookline Avenue/Boylston Street |
| 2. | Kenmore Square (Commonwealth Avenue/Brookline Avenue/Beacon Street) |
| 3. | Massachusetts Avenue at Beacon Street |
| 4. | Dartmouth Street at Saint James Avenue |
| 5. | Arlington Street at Beacon Street |
| 6. | Arlington Street at Stuart Street/Columbus Avenue |

Using the data and information collected for the AM and PM peak periods, SYNCHRO[1] was used to assess the roadway capacity and quality of traffic flow at the intersections. The analyses were conducted in a manner consistent with the Highway Capacity Manual (HCM) methodologies.[2] HCM software was used to evaluate the driving conditions at signalized and unsignalized intersections in terms of level-of-service (LOS) ratings from A through F. LOS A represents the best operating conditions (little to no delay), while LOS F represents the worst operating conditions (very long delay). LOS E represents the conditions when a roadway is operating at capacity (acceptable delay for urban intersections). Table 2-11 shows the control delays associated with each level of service for signalized and unsignalized intersections, respectively.

**TABLE 2-11**
**Level of Service Criteria for Signalized Intersections (2010)**

| Level of Service | Control Delay (seconds of delay per vehicle) |
|---|---|
| A | ≤ 10 |
| B | > 10-20 |
| C | > 20-35 |
| D | > 35-55 |
| E | > 55-80 |
| F | > 80 |

Table 2-12 shows the LOS of each of the key intersections in the AM and PM peak hours. In addition to the LOS, the 50th and 95th percentile queue lengths on each intersection approach were calculated.[3] The 50th percentile queue length reflects average peak-hour condition, while the 95th percentile queue length reflects

[1] Trafficware Inc., Synchro Studio 8, Synchro plus SimTraffic, Build 801, Version 563, Sugar Land, Texas.
[2] Highway Capacity Manual, HCM 2010, Volume 3: Interrupted Flow, Transportation Research Board of the National Academies, Washington DC, December 2010.
[3] A queue consists of the vehicles waiting during a red phase at a traffic signal.

conditions that occur 95% of the time. For simplicity, the total queue length in feet is divided by 20 to reflect the number of vehicles in a queue; this reflects an average length of a vehicle plus buffers between stopped vehicles. The LOS rating represents the intersection delay as a whole, but the queue length determines if designated turn lanes are adequate and if a traffic queue might interfere with an upstream intersection.

During the AM peak hour, the key intersections ranged from LOS C to LOS F, while the LOS of the key arterials ranged from LOS A to LOS D. During the PM peak hour, most of the key intersections operated at LOS D, with the exception of Park Drive at Brookline Avenue/Boylston Street (LOS E) and Dartmouth Street at Saint James Avenue (LOS C). Figure 2-6 and Figure 2-7 show the LOS for key arterials and key intersections in the AM and PM peak hours, respectively.

**TABLE 2-12**
**Analysis of Key Intersections (2010)**

| Intersection | Overall Delay[4] | Level Of Service | Worst Approach | 50th % Queue[5] | 95th % Queue[6] |
|---|---|---|---|---|---|
| AM PEAK PERIOD | | | | | |
| Park Drive at Brookline Avenue/Boylston Street | 76.2 | E | Boylston Street southwest direction | Exceeds capacity | Exceeds capacity |
| Kenmore Square | 99.7 | F | Beacon Street Northeast direction | 3 | 4 |
| Massachusetts Avenue at Beacon Street | 31.8 | C | Beacon Street westbound | 4 | Exceeds capacity |
| Dartmouth Street at Saint James Avenue | 22.2 | C | Dartmouth Street northbound | 7 | 9 |
| Arlington Street at Beacon Street | 35.1 | D | Storrow Drive southbound | Exceeds capacity | Exceeds capacity |
| Arlington Street at Stuart Street/Columbus Avenue | 75.0 | E | Arlington Street southbound | Exceeds capacity | Exceeds capacity |
| PM PEAK PERIOD | | | | | |
| Park Drive at Brookline Avenue/Boylston Street | 63.0 | E | Boylston Street Southwest direction | Exceeds capacity | Exceeds capacity |
| Kenmore Square | 42.5 | D | Commonwealth Avenue eastbound | Exceeds capacity | Exceeds capacity |
| Massachusetts Avenue at Beacon Street | 45.3 | D | Massachusetts Avenue southbound | 23 | Exceeds capacity |
| Dartmouth Street at Saint James Avenue | 24.9 | C | Dartmouth Street northbound | 9 | Exceeds capacity |
| Arlington Street at Beacon Street | 44.5 | D | Beacon Street westbound | Exceeds capacity | Exceeds capacity |
| Arlington Street at Stuart Street/Columbus Avenue | 48.1 | D | Stuart Street eastbound | Exceeds capacity | Exceeds capacity |

[4] Overall delay is measured in seconds of delay per vehicle.
[5] 50th percentile queues are measured in number of vehicles.
[6] 95th percentile queues are measured in number of vehicles.

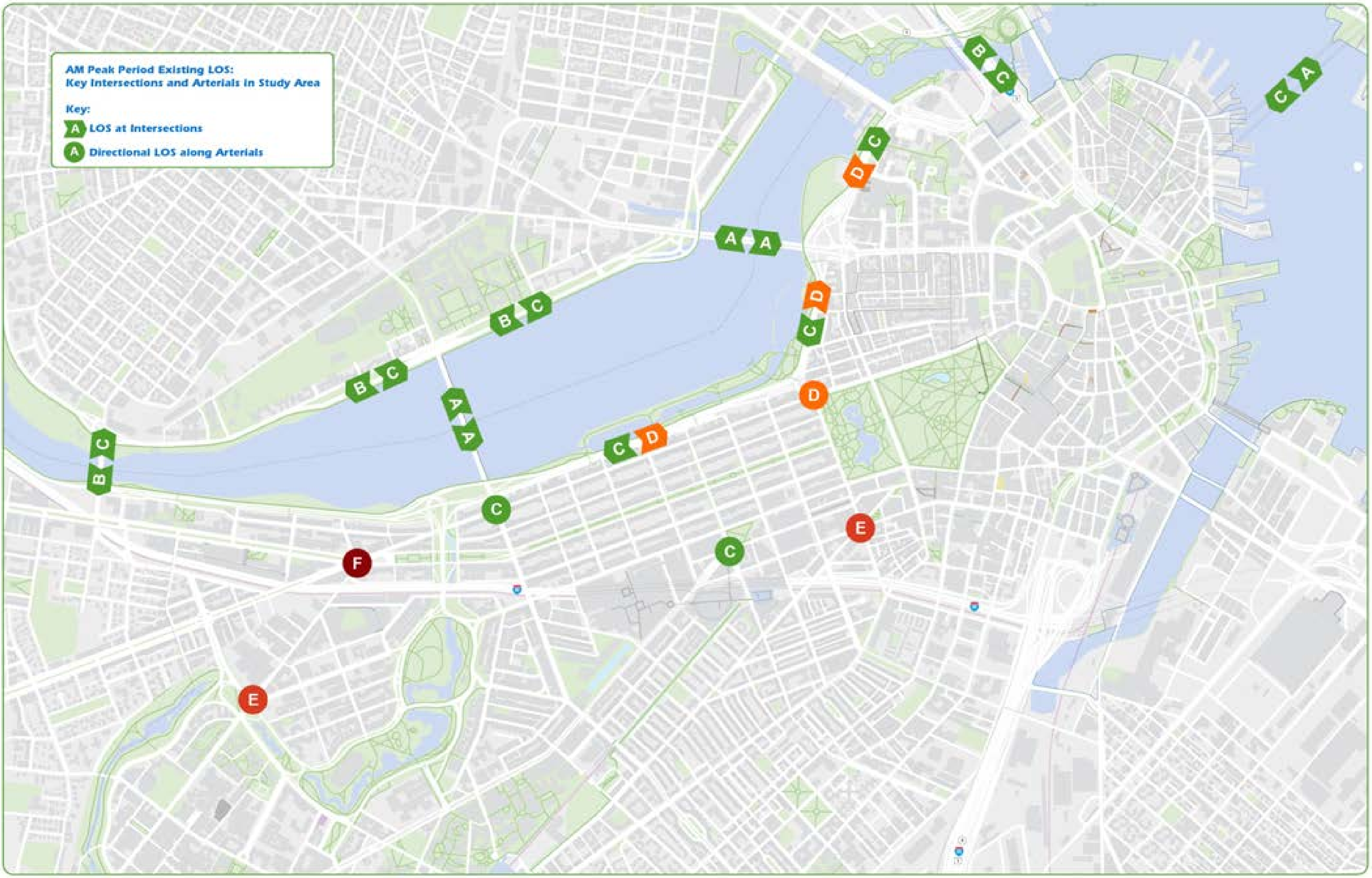



**FIGURE 2-6**
**AM-Peak-Hour Existing LOS**
**Key Intersections and Arterials in the Study Area**

massDOT
Massachusetts Department of Transportation

Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

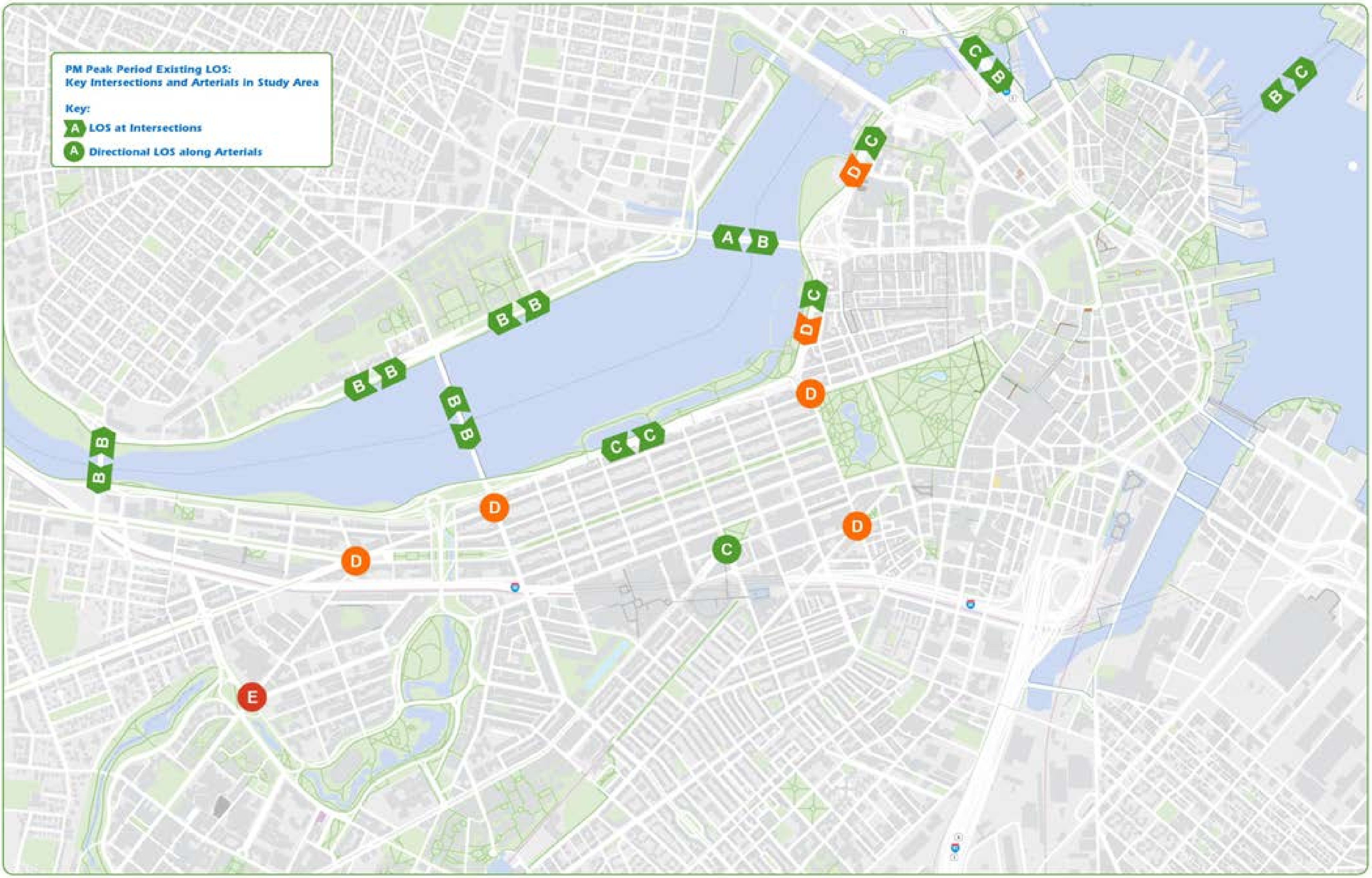



FIGURE 2-7
PM-Peak-Hour Existing LOS
Key Intersections and Arterials in the Study Area

massDOT
Massachusetts Department of Transportation
Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

## 2.3 CRASH DATA

The existing crash data for the study area were reviewed using the crash report database created by MassDOT's Registry of Motor Vehicles (RMV) Division. However, the number of crashes may be underreported because only operator crash reports were provided to the RMV by the City of Boston.

### 2.3.1 Massachusetts Turnpike Crash Data

Crash data were obtained for all of the crashes that occurred on the Massachusetts Turnpike, in both directions combined, between the Allston toll plaza and East Boston from 2006 to 2010. The database contained a total of 520 crash reports; they included the crash date, location, roadway junction type, weather conditions, crash severity, type, and amount of ambient lighting. The "weather conditions" category indicates if there was precipitation or fog at the time of the crash or if it was a cloudy day. The crash severity data indicate whether the crash involved property damage, injuries, or fatalities. The categories of crash type are rear-end, sideswipe, angle, and single-vehicle. The "ambient lighting" category indicates the natural lighting conditions at the time of the crash—daylight, dusk, night, and dawn—and whether or not the roadway had artificial lighting.

The crash data summaries are displayed in Table 2-13 (the crash severity and weather conditions); Table 2-14 (the crash type and weather conditions); Table 2-15 (the crash severity and crash type); and Table 2-16 (the crash type and ambient light).

Most of the crashes—56 percent—occurred under clear conditions, while 26 percent of the crashes occurred when there was precipitation (rain, snow, or mixed precipitation). The most common crash type was rear-end, and weather did not appear to have been a factor in the majority of those crashes. However, rain was indicated as a contributing factor in single-vehicle crashes. Based on these data it would appear that with the majority of the crashes being rear-end with property damage, the predominant cause can be assumed to be attributed to congested conditions.

Viewing the data on crash severity and crash type together (Table 2-15) indicates which crash type results in the most property damage (non-injury) or injuries. According to the data, rear-end crashes accounted for the majority of crashes (41 percent), while single-vehicle crashes accounted for 30 percent and angle crashes accounted for 11 percent. Of the rear-end crashes, 75 percent were non-injury property damage, and 21 percent involved an injury. Of the single-vehicle crashes, 70 percent were non-injury property damage, and 26 percent involved an injury.

**TABLE 2-13**
**Crash Severity and Weather Conditions**

| Crash Severity | Weather Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Clear | Cloudy | Fog | Mixed Precipitation | Not Reported | Other | Rain | Severe Crosswinds | Snow |
| Fatal injury | 2 | | | | | | | | |
| Non-fatal injury | 60 | 18 | | 2 | 5 | | 22 | | 5 |
| Not reported | 14 | 2 | | | | | 3 | | 1 |
| Property damage only (none injured) | 213 | 54 | | 4 | 8 | 5 | 84 | | 14 |
| Unknown | 2 | 2 | | | | | | | |
| Total | 291 | 76 | | 6 | 13 | 5 | 109 | | 20 |

**TABLE 2-14**
**Crash Type and Weather Conditions**

| Crash Type | Weather Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Clear | Cloudy | Fog | Mixed Precipitation | Not Reported | Other | Rain | Severe Crosswinds | Snow |
| Angle | 28 | 6 | | 2 | 1 | | 16 | | 4 |
| Head-On | 2 | | | | | | | | 1 |
| Not reported | 3 | | | | 1 | 1 | 1 | | |
| Rear-end | 144 | 32 | | 2 | 2 | 2 | 29 | | 3 |
| Rear-to-rear | 1 | | | | | | | | |
| Sideswipe, same direction | 48 | 14 | | | 3 | 2 | 11 | | 4 |
| Single-vehicle crash | 64 | 24 | | 2 | 6 | | 51 | | 8 |
| Unknown | 1 | | | | | | 1 | | |
| Total | 291 | 76 | | 6 | 13 | 5 | 109 | | 20 |

As can be seen in Table 2-15, 61 percent of the crashes occurred during the day and 32 percent occurred at night. Most of the daylight crashes were rear-end, and most of the night-time crashes were rear-end or single-vehicle. Crashes that occurred during daylight included single-vehicle (24 percent), sideswipe (18 percent), and angle (13 percent) crashes.

Using the crash database's longitude and latitude coordinates, CTPS geocoded each crash to determine whether there were any crash patterns at the crash location. The findings indicated that there were crash clusters between the St. Mary's Street and Beacon Street overpasses, in the Prudential Tunnel, and approaching the I-93 interchange from both directions.

There were 96 crashes between Saint Mary's Street and Beacon Street (Figure 2-8), most of which were rear-end and single-vehicle crashes. Within the Prudential Tunnel (Figure 2-9), the preponderance of crashes were rear-end, single-vehicle, and sideswipe. The approaches to I-93 from the eastbound and westbound Turnpike (Figure 2-10) experienced mostly rear-end and angle crashes. Figures 2-8, 2-9, and 2-

10 show the geocoded crash locations in the west, central, and eastern portions of the study area, with the number of crashes of each type indicated separately.

Based on the geocoded crashes, eastbound crashes are most likely caused by the congested conditions and lane changes associated with the traffic destined for the Prudential Tunnel off-ramp. In the westbound direction, the crashes most likely are occurring because of the westbound on-ramps because there are forced-merge areas at three of the four on-ramps—only the Dartmouth Street on-ramp provides an additional lane for entering vehicles.

**TABLE 2-15**
**Crash Severity and Crash Type**

| | Crash Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Crash Severity | Angle | Head -On | Not Reported | Rear-End | Rear-to-Rear | Sideswipe, Same Direction | Single –Vehicle Crash | Unknown |
| Fatal injury | | 1 | | | | | 1 | |
| Non-fatal injury | 12 | | | 44 | | 15 | 41 | |
| Not reported | 4 | | 2 | 6 | | 3 | 5 | |
| Property damage only (none injured) | 41 | 2 | 4 | 160 | 1 | 64 | 108 | 2 |
| Unknown | | | | 4 | | | | |
| Total | 57 | 3 | 6 | 214 | 1 | 82 | 155 | 2 |

**TABLE 2-16**
**Crash Type and Ambient Lighting Conditions**

| Crash Type | Ambient Lighting Conditions | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dark-Lighted Roadway | Dark-Roadway Not Lighted | Dark Unknown Roadway Lighting | Dawn | Daylight | Dusk | Not Reported | Other |
| Angle | 11 | 2 | | 1 | 40 | 3 | | |
| Head-on | 2 | | | | 1 | | | |
| Not reported | 2 | | | | 3 | | 1 | |
| Rear-end | 56 | 6 | 1 | 2 | 138 | 8 | 1 | 2 |
| Rear-to-rear | | | | | 1 | | | |
| Sideswipe, same direction | 17 | 2 | | 2 | 58 | 1 | 2 | 4 |
| Single-vehicle crash | 58 | 8 | 3 | 3 | 77 | 2 | | |
| Unknown | | | | | 1 | 1 | | |
| Total | 146 | 18 | 4 | 8 | 319 | 15 | 4 | 6 |

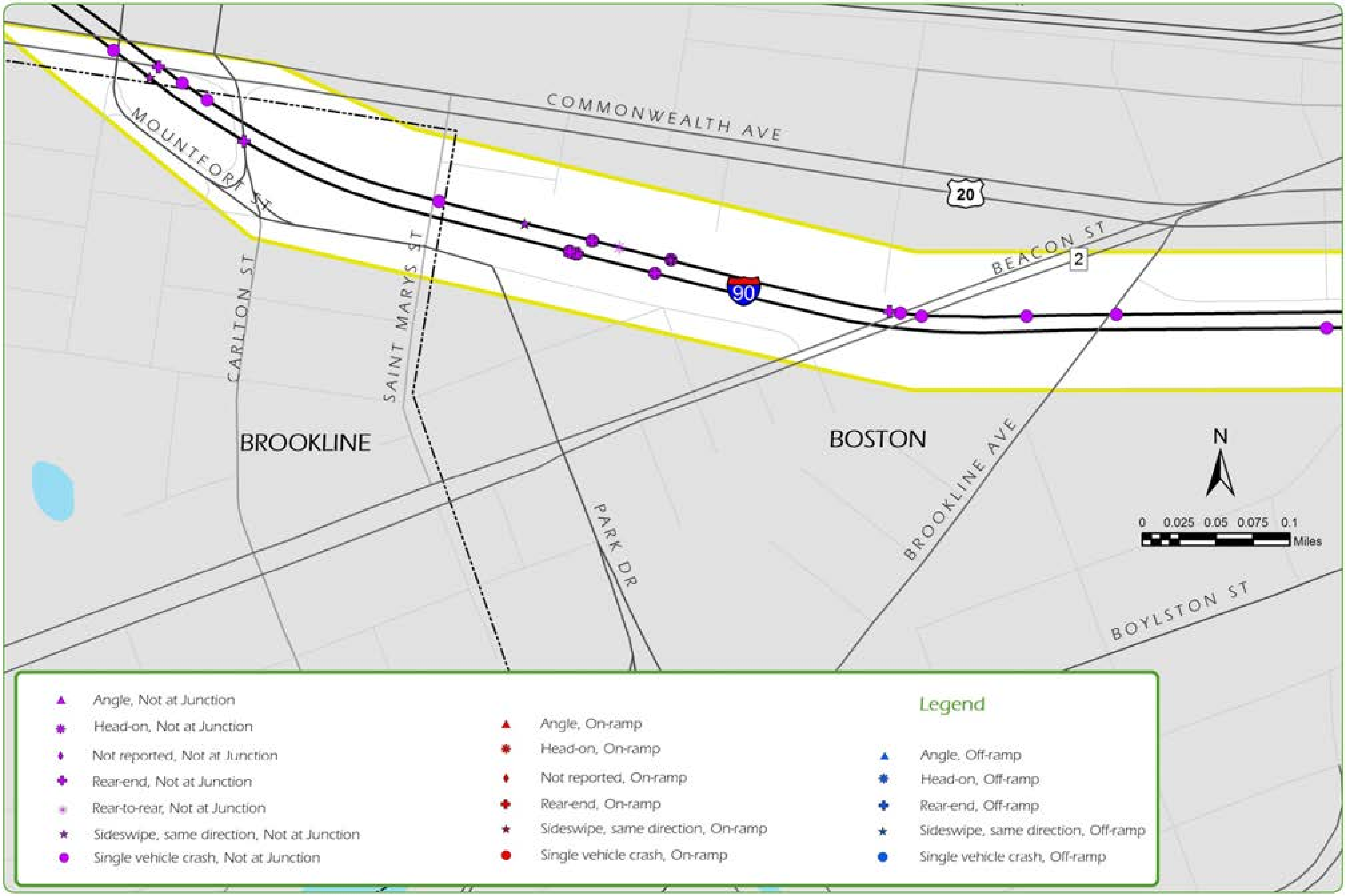



**FIGURE 2-8**
**2006–2010 Crashes by Type and Roadway Junction**


**FIGURE 2-9**
**2006–2010 Crashes by Type and Roadway Junction**

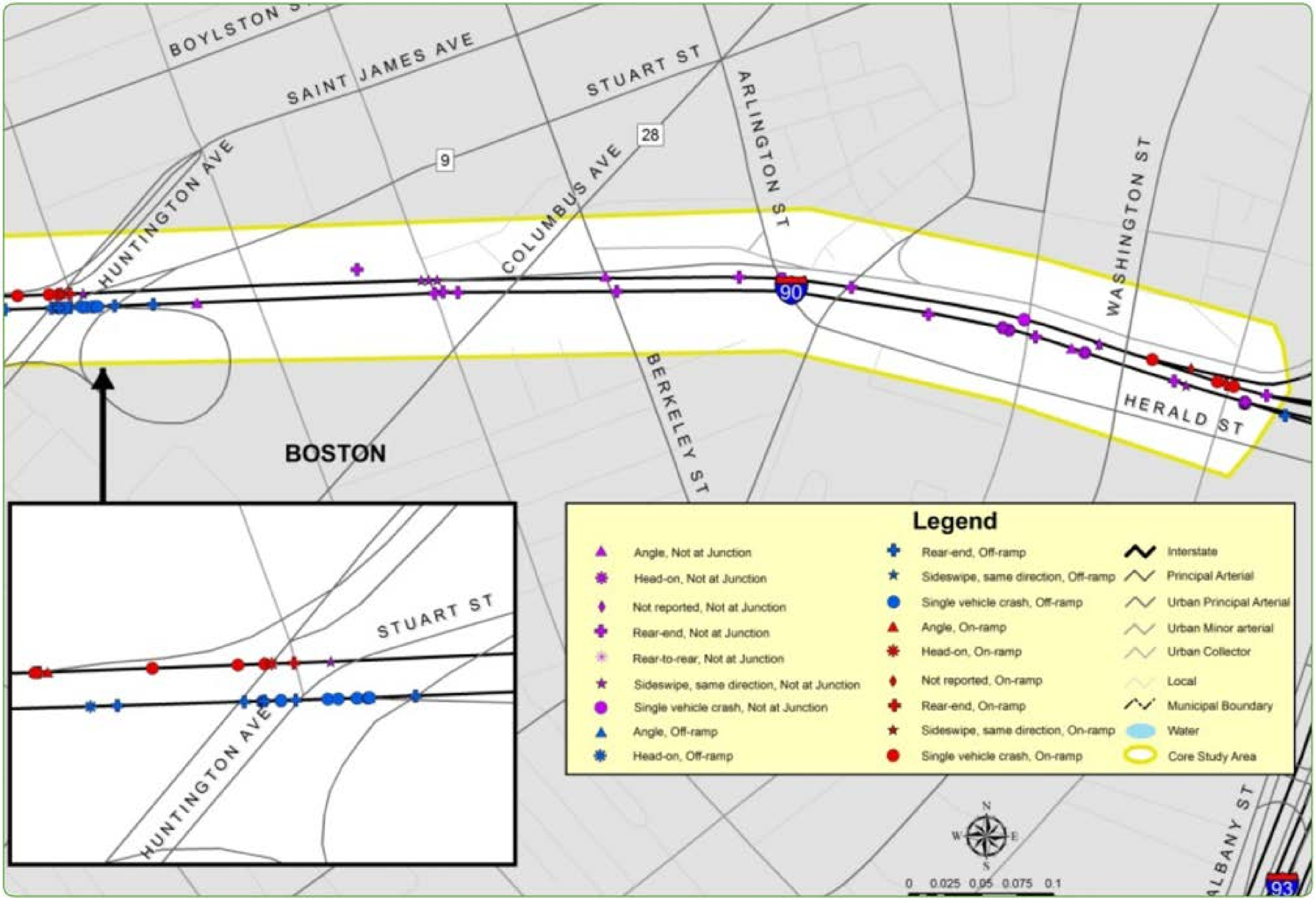



**FIGURE 2-10**
**2006–2010 Crashes by Type and Roadway Junction**

## 2.4 TRANSIT DATA

Within the study area, the Massachusetts Bay Transportation Authority (MBTA) operates three rapid transit lines, one commuter rail line (with multiple commuter rail lines converging at Back Bay Station), and 55 bus routes, with Amtrak also providing passenger service in this area. Boarding information was collected by the MBTA. The data presented in this section were current as of the spring of 2014.

### 2.4.1 Rapid Transit Lines

The Silver, Orange, and Green lines provide transit service in the study area. The MBTA collects daily weekday passenger boarding information using CharlieCard and CharlieTicket data. For the aboveground stations, visual counts of passenger boardings were taken. Using counts taken from 2007 to 2012, daily average and AM and PM peak-period passenger boardings were calculated. Tables 2-17, 2-18, and 2-19 summarize boardings by transit line.

The Silver Line is split into two parts—an aboveground bus rapid transit route between South Station, Downtown Crossing, and Dudley Square (Routes SL 4 and SL5) and several bus rapid transit routes originating at South Station that are destined for Logan Airport and the South Boston Waterfront (Routes SL 1 and SL2). The SL5 route has 10 stops within the study area and provides service between Roxbury, the South End, Bay Village, and downtown Boston via Washington Street. The 10 stops had more than 8,750 daily weekday boardings, with 2,019 boardings during the AM peak period (7:00 AM–9:00 AM) and 1,518 boarding during the PM peak period (4:00 PM–6:00 PM).

The SL1 and SL2 routes connect South Station with Logan Airport and South Boston via a tunnel under Fort Point Channel; the Ted Williams Tunnel; and local Boston roadways. The Federal Courthouse and World Trade Center stations lie within the study area and provide access to the South Boston Waterfront and the Boston Convention and Exposition Center. The two stations had a combined total nearly 3,100 average weekday boardings, with 110 boardings during the AM peak period (7:00 AM–9:00 AM) and 1,262 boardings during the PM peak period (4:00 PM–6:00 PM).

The Orange Line provides north–south heavy rail transit service between Oak Grove Station in Malden and Forest Hills Station in Jamaica Plain, with five stations serving destinations in the study area. The Ruggles, Massachusetts Avenue, Back Bay, Tufts Medical Center, and Chinatown stations provide access to Chinatown, Bay Village, South End, Back Bay, and the Longwood Medical Area. This subway line had slightly more than 46,000 passengers boarding on an average weekday, with 5,664 boarding during the AM peak period and 11,860 boarding during the PM peak period. More than twice as many passengers boarded the Orange Line during the evening peak period as during the morning peak period.

The Green Line provides light rail service, with multiple branches serving Boston, Cambridge, Brookline, and Newton. There are 13 stations that serve the study area. The Boylston, Arlington, Copley, Hynes, Kenmore, Prudential (E Branch), and Symphony (E Branch) underground stations and the Longwood (D Branch), Fenway (D Branch), Northeastern (E Branch), Museum of Fine Arts (E Branch), Longwood Medical Area (E Branch), and Brigham Circle (E Branch) aboveground stations provide access to Chinatown, Back Bay, Fenway, and the Longwood Medical Area. In total, slightly more than 60,000 passengers boarded the Green Line on an average weekday, with 5,300 passengers boarding during the AM peak period and almost 14,000 boarding during the PM peak period.

**Table 2-17**
**Silver Line Boardings: Weekday and AM and PM Peak Periods**

| Stations | Weekday Daily Boardings | | |
|---|---|---|---|
| | AM Peak Period | PM Peak Period | Average Weekday |
| World Trade Center[1] – SL1, SL2, SL Waterfront | 38 | 368 | 2,156 |
| Courthouse[1] – SL1, SL2, SL Waterfront | 72 | 894 | 931 |
| Washington Street at Essex Street[2] – SL4, SL5 | 44 | 83 | 430 |
| Washington Street at Tufts Medical Centert[2] – SL4, SL5 | 517 | 422 | 2,472 |
| Washington Street at Herald Street[2] – SL4, SL5 | 70 | 118 | 575 |
| Washington Street at East Berkeley Street[2] – SL4, SL5 | 244 | 232 | 1,374 |
| Washington Street at Union Park[2] – SL4, SL5 | 315 | 292 | 1,561 |
| Washington Street at East/West Newton Street[2] – SL4, SL5 | 282 | 323 | 1,570 |
| Washington Street at Worcester Street[2] – SL4, SL5 | 213 | 131 | 817 |
| Washington Street at Massachusetts Avenue[2] – SL4, SL5 | 206 | 143 | 1,142 |
| Washington St at Lenox Street[2] – SL4, SL5 | 99 | 65 | 508 |
| Washington Street at Melnea Cass Boulevard[2] – SL4, SL5 | 68 | 79 | 466 |
| TOTAL | 2,129 | 2,780 | 11,844 |

[1] Source: Fiscal Year 2012 automated fare collection (no noninteraction).
[2] Source: Fall 2012 automatic passenger counters.

**Table 2-18**
**Orange Line Boardings: Weekday and AM and PM Peak Periods**

| Stations | Weekday Daily Boardings | | |
|---|---|---|---|
| | AM Peak Period | PM Peak Period | Average Weekday |
| Ruggles | 1,183 | 2,483 | 10,070 |
| Mass Ave | 1,009 | 1,196 | 6,148 |
| Back Bay | 2,739 | 4,876 | 17,778 |
| Tufts Medical Center | 483 | 1,774 | 5,966 |
| Chinatown | 251 | 1,530 | 6,154 |
| TOTAL | 5,664 | 11,860 | 46,116 |

Source: Fiscal Year 2012 automated fare collection (no noninteraction).

**Table 2-19**
**Green Line Boardings: Weekday and AM and PM Peak Periods**

| Stations | Weekday Daily Boardings | | |
|---|---|---|---|
| | AM Peak Period | PM Peak Period | Average Weekday |
| Boylston[1] | 276 | 1,495 | 6,727 |
| Arlington[1] | 367 | 2,678 | 8,337 |
| Copley Square[1] | 1,306 | 3,267 | 14,789 |
| Hynes[1] | 927 | 1,796 | 9,330 |
| Kenmore Square[1] | 927 | 1,683 | 9,340 |
| Longwood (D Line)[2] | 240 | 927 | 2,719 |
| Fenway (D Line)[2] | 371 | 786 | 3,488 |
| Prudential[1] | 298 | 754 | 3,614 |
| Symphony[1] | 295 | 239 | 1,725 |
| Northeastern (E Line)[3] | 235 | 412 | 2,625 |
| Museum of Fine Arts (E Line) [3] | 116 | 401 | 1,676 |
| Longwood Medical (E Line) [3] | 224 | 996 | 3,793 |
| Brigham Circle (E Line)[4] | 266 | 770 | 2,535 |
| TOTAL | 5,306 | 13,940 | 61,436 |

[1] Source: Fiscal Year 2012 Automated Fare Collection (no noninteraction).

[2] Source: CTPS counts, 2011.

[3] Source: CTPS counts, 2010.

[4] Source: CTPS counts, 2007.

## 2.4.2 Commuter Rail Line

The Framingham/Worcester commuter rail line travels through the study area, stopping at Yawkey Station and Back Bay Station. In the spring of 2014, upgrades to Yawkey Station were completed. The upgrades to the station, tracks, and platforms included making the station accessible to people with disabilities and allowing both tracks to be used. (Previously, only one of the two tracks had been usable at Yawkey Station for passengers; the other track could only be used by trains passing through the station.) When the second track became available, service was increased on the Framingham/ Worcester Line.

This line runs parallel to the Massachusetts Turnpike through the study area, with a small portion curving away from the Turnpike at Back Bay Station. This increased gap between the commuter rail line and the Turnpike provided the necessary space for the eastbound Copley Square exit ramp to diverge from the Turnpike, rise in elevation, cross the commuter rail tracks, and loop around to connect with Huntington Avenue and Stuart Street. As of June 2015, there were nine inbound trains (to Boston) during the AM peak period (6:30 AM–9:30 AM) and eight outbound trains during the PM peak period (4:00 PM–7:00 PM) on the Framingham/Worcester Line.

Based on the most recent data collected for the commuter rail lines (MBTA 2008), the inbound AM peak-period trains were averaging 5,200 daily passengers, and the seven outbound trains carried 4,700 passengers out of the city each day. Therefore, there are a total of almost 10,000 peak-period passengers per day, which is 77.7 percent of the total average weekday ridership. The average percentage of directional weekday ridership that occurred during the AM inbound and PM outbound peak periods was 81.1 percent and 74.3 percent, respectively. Table 2-20 summarizes the commuter rail ridership volumes by train.

**Table 2-20**
**Commuter Rail Ridership**
**Volumes by Train: Summary**

| | AM Inbound (6:30 AM-9:30 AM) | |
|---|---|---|
| | Arrival Time | Passenger Volume |
| AM Inbound (6:30 AM-9:30 AM) | | |
| P500 | 6:31 AM | 264 |
| P502 | 7:08 AM | 746 |
| P504 | 7:46 AM | 752 |
| P506 | 8:11 AM | 847 |
| P508 | 8:23 AM | 1,179 |
| P510 | 8:56 AM | 596 |
| P512 | 9:08 AM | 621 |
| P514 | 9:36 AM | 224 |
| *Total Boardings* | | *5,229* |
| PM Outbound (4:00 PM-7:00 PM) | | |
| P519 | 4:05 PM | 632 |
| P521 | 4:27 PM | 407 |
| P523 | 5:00 PM | 1,062 |
| P525 | 5:15 PM | 673 |
| P527 | 5:35 PM | 829 |
| P529 | 6:15 PM | 718 |
| P531 | 6:30 PM | 389 |
| *Total Boardings* | | *4,710* |

## 2.4.3 MBTA Bus Routes

The MBTA operates numerous bus routes in the study area, providing local, crosstown, and express service. Seven of those bus routes (Routes 501, 504, 505, 553, 554, 556, and 558) use the Massachusetts Turnpike; they serve commuters traveling from Waltham, Watertown, Newton, and Brighton to downtown Boston. There are local bus routes that serve the Kenmore Square area (Routes 8, 19, 57, 60, and 65), and other local bus routes that serve the study area, such as the busy bus Route 1 on Massachusetts Avenue. Some of the other local routes that serve the study area are

Routes CT1, 9, 10, 39, 43, and 55. Table 2-21 summarizes bus passenger boarding by bus route type.

**Table 2-21**
**Bus Route AM- and PM-Peak-Period Boardings: Summary**

| Description | AM Peak Period | | PM Peak Period | | Daily Total | |
|---|---|---|---|---|---|---|
| | Boardings | Percent | Boardings | Percent | Boardings | Percent |
| Frequent-Service Bus Routes (Routes 8, 9, 39, 57, 60) | 21,503 | 81.76% | 24,277 | 86.51% | 134,068 | 90.90% |
| Special-Destination Routes (Routes 10, 19, 43, 55, 65) | 509 | 1.94% | 123 | 0.44% | 735 | 0.50% |
| Express Bus Routes (Routes 501, 504, 505, 553, 554, 556) | 3,187 | 12.12% | 2,568 | 9.15% | 8,337 | 5.65% |
| Crosstown Bus Routes (Route CT1) | 1,101 | 4.19% | 1,096 | 3.91% | 4,353 | 2.95% |
| TOTAL | 26,300 | | 28,064 | | 147,493 | |

Based on the passenger boarding counts, almost 147,493 passengers traveled on buses within and through the study area. The AM and PM peak periods have comparable ridership counts, with 26,300 passengers traveling by bus in the AM peak period and 28,064 in the PM peak period.

# 2.5 ENVIRONMENTAL CONDITIONS

Using data from the Massachusetts Office of Geographic Information (MassGIS), maps showing environmental constraints and open space restrictions in the study area were produced. These maps are important for determining the feasibility of permitting, designing, and constructing proposed transportation improvements. The maps also ensure that the connectivity of open spaces and bicycle and pedestrian accommodations is being addressed. They are also useful for identifying any potential environmental impacts that might increase the cost, require mitigation, or make the construction of a proposed improvement infeasible.

## 2.5.1 Environmental Constraints

Figure 2-11 shows the existing environmental constraints in the study area based on environmental data from MassGIS. There are four types of environmental constraints in the study area: underground storage tanks, anadromous (migrating) fish, historic places, and wetlands.

## Underground Storage Tanks

The underground storage tanks, many of which store fuel for existing service stations, are located along principal arterials (Commonwealth Avenue, Boylston Street, Saint James Street, Columbus Avenue, and Marginal Road) in Boston.

## Anadromous Fish

An anadromous fish is born in fresh water, spends most of its life in the sea, and returns to fresh water to spawn. Anadromous fish are present at the Charles River Dam next to the Museum of Science on Route 28; it is within the study area but not near the Massachusetts Turnpike.

## Wetlands

Wetlands are areas either inundated or saturated for varying periods during the growing season, resulting in the development of specially adapted plants that promote the development of adaptable wetland plants. As required by Section 404 of the federal Clean Water Act of 1977, impacts to wetlands must be avoided or minimized, or the damaged wetland area must be replaced.[7] State law dictates that the Department of Environmental Protection enforce Massachusetts General Law Chapter 131 Section 40 of the Wetlands Protection Act to ensure that public interests will be protected; the law deals with issues such as drinking water, groundwater, pollution prevention, flood control, fisheries, and wildlife habitat. Figure 2-12 shows that within the study area, part of the Muddy River, which is an inland wetland, travels from the Fens and flows under the Massachusetts Turnpike.

## Historic Places

There are four buildings and six historic districts located within the study area that are listed on the Massachusetts State Register of Historic Places (SRHP). There are two historic preservation laws that protect historic places from inappropriate alterations, demolition, or any other adverse impact. The federal National Historic Preservation Act, Section 106, mandates a review of all locations that are included in or might be eligible for the National Register of Historic Places. Such a review would be required for any new

[7] Philip J. Quarterman (Senior Wetland Biologist, W&H Pacific Inc.) and Michael W. Shippey (Wetland Specialist, ODOT Environ. Services), "AASHTO's Wetland Manual for Transportation Designers," Conference Proceeding Paper presented to the American Association of State Highway and Transportation Officials, September 1996.

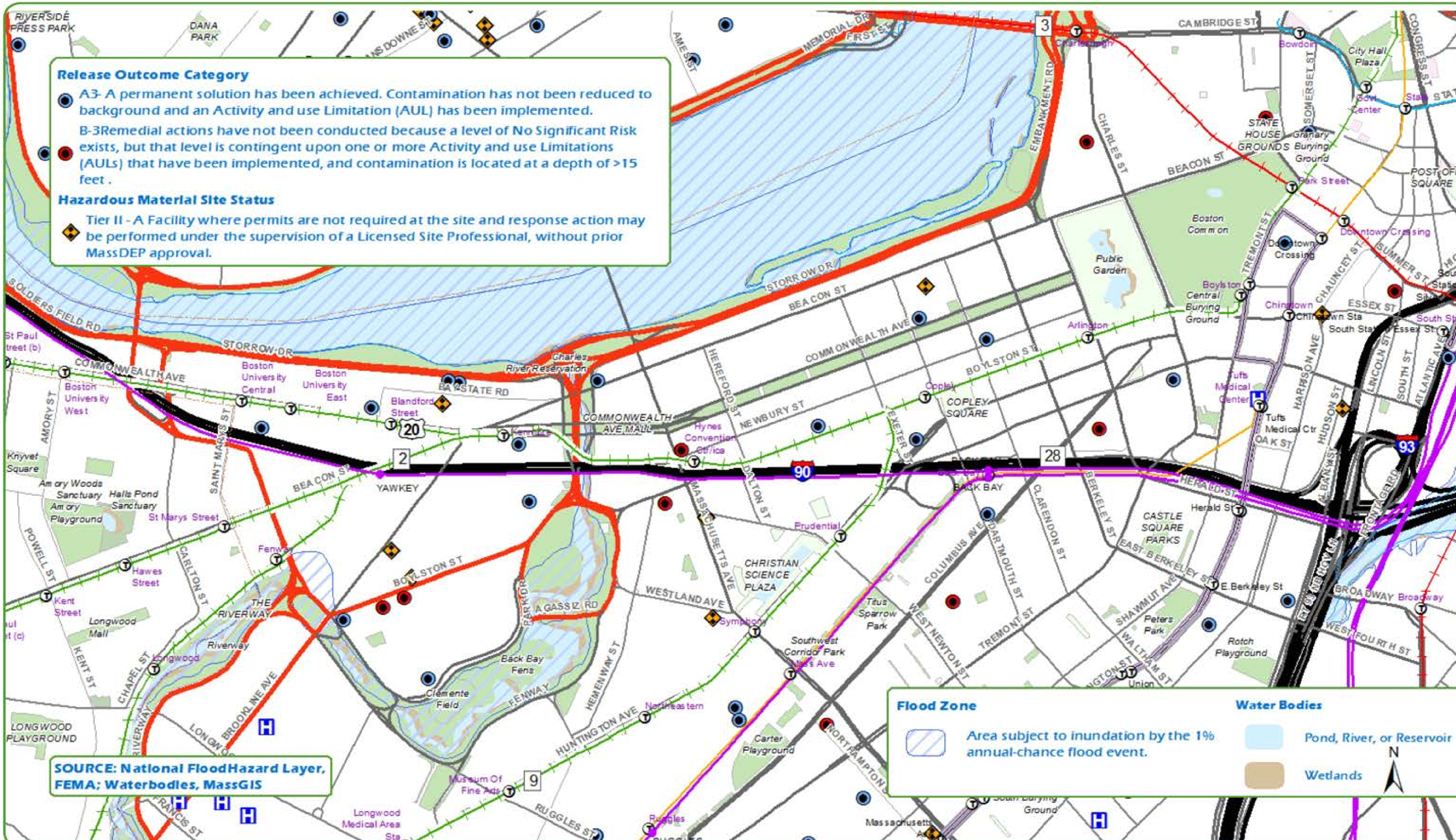



FIGURE 2-11
Back Bay Environmental Constraints and Flood Area

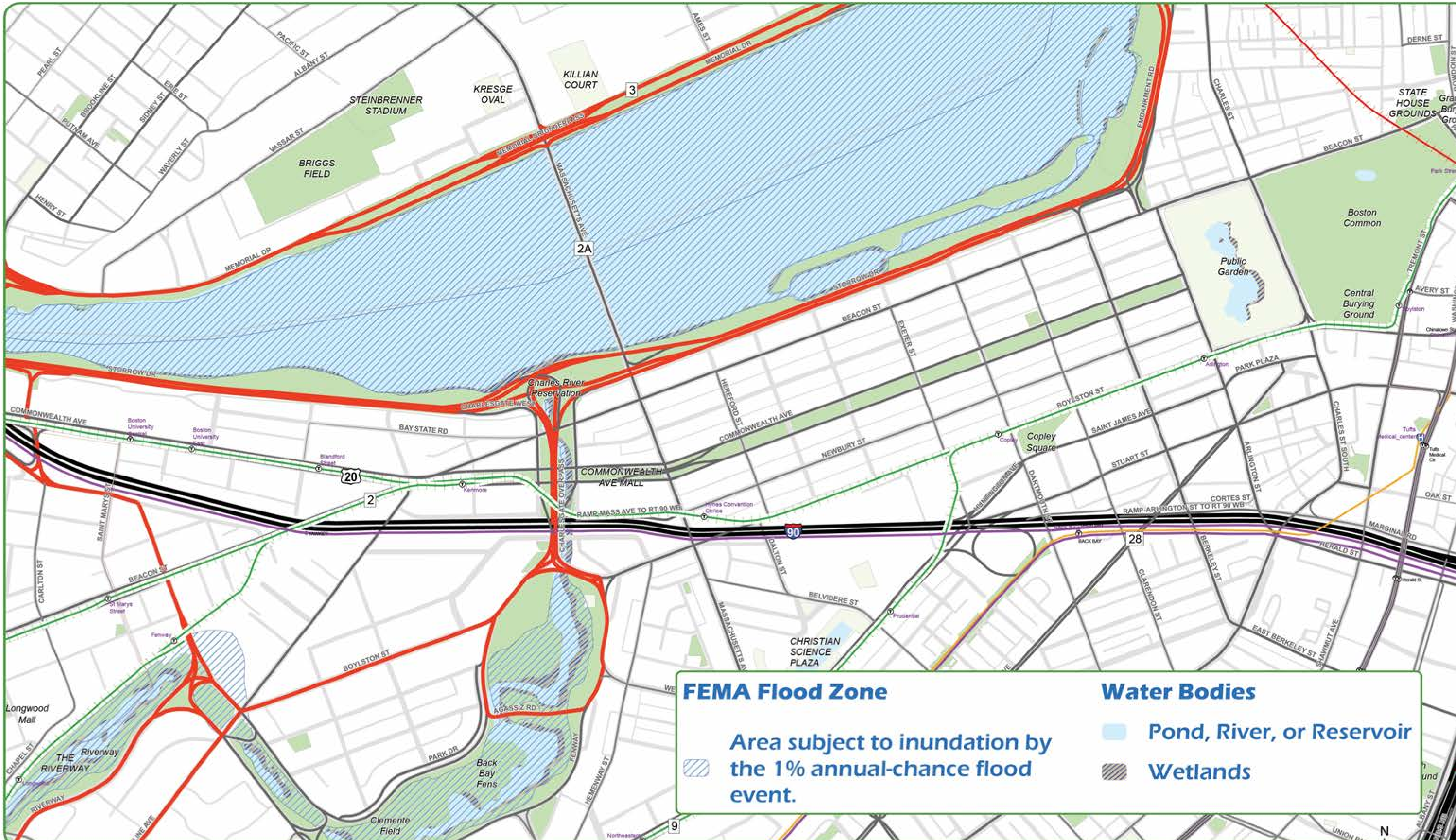



FIGURE 2-12
Back Bay Wetland Areas

access ramps to or from I-90. State law dictates that the Massachusetts Historic Commission identify, evaluate, and protect important historic assets by maintaining an inventory of historic assets in the SRHP. As required under Massachusetts General Law Chapter 9, Sections 26-27C, as amended by Chapter 254 of the Acts of 1988 (950 CMR 71.00), any potential impacts on places listed on the SRHP must be reported early in the planning process and would need to eventually be reviewed by the Massachusetts Historical Commission under this law.

Figure 2-13 shows four buildings on the SRHP that are within the study area, including the Peter Fuller Building at the intersection of Commonwealth Avenue and the Boston University Bridge, the Fenway Studios along Ipswich Street between Charlesgate East and Boylston Street, the Youth's Companion Building at the corner of Columbus Avenue and Berkeley Street, and One Bay Street at the corner of Tremont Street and Marginal Road. It also shows the six districts that are located within the core study: the Bay Village Historic District, the South End Landmark District, the South End Historic District, the Back Bay Historic District, the Back Bay Architectural District, and the Olmsted Park System.

### 2.5.2 Open Space Restrictions

The term "open space" refers to lands owned by federal, state, county, municipal, or nonprofit enterprises that are protected from development. Figure 2-14 shows the locations in the study area where there are existing open space restrictions. There are several types of open space restrictions in federal legislation: agriculture, recreation or conservation, historical or cultural, recreational, water supplies, and "other." Under the US Department of Transportation Act, Section 4(f), the federal government cannot approve the use (to construct new highway ramps, for example) of these publicly owned parks or recreation areas unless there is no feasible alternative and the design minimizes the harm to the open space. In addition, the Massachusetts Executive Office of Energy and Environmental Affairs preserves and protects open space through Article 97of the Massachusetts Constitution in order to ensure that there is no net loss of protected open space.

There is a mix of recreation, historic, conservation, and other uses in the study area and its environs. The open space areas near the Bowker Overpass are part of the Olmsted Park System and are protected by both state and federal law as National Historic Parkland. This mix of uses provides opportunities to ensure the connectivity of open spaces and of bicycle and pedestrian paths and routes. While it may be possible to mitigate open space restrictions, the mitigation would result in increased costs and environmental permitting delays.

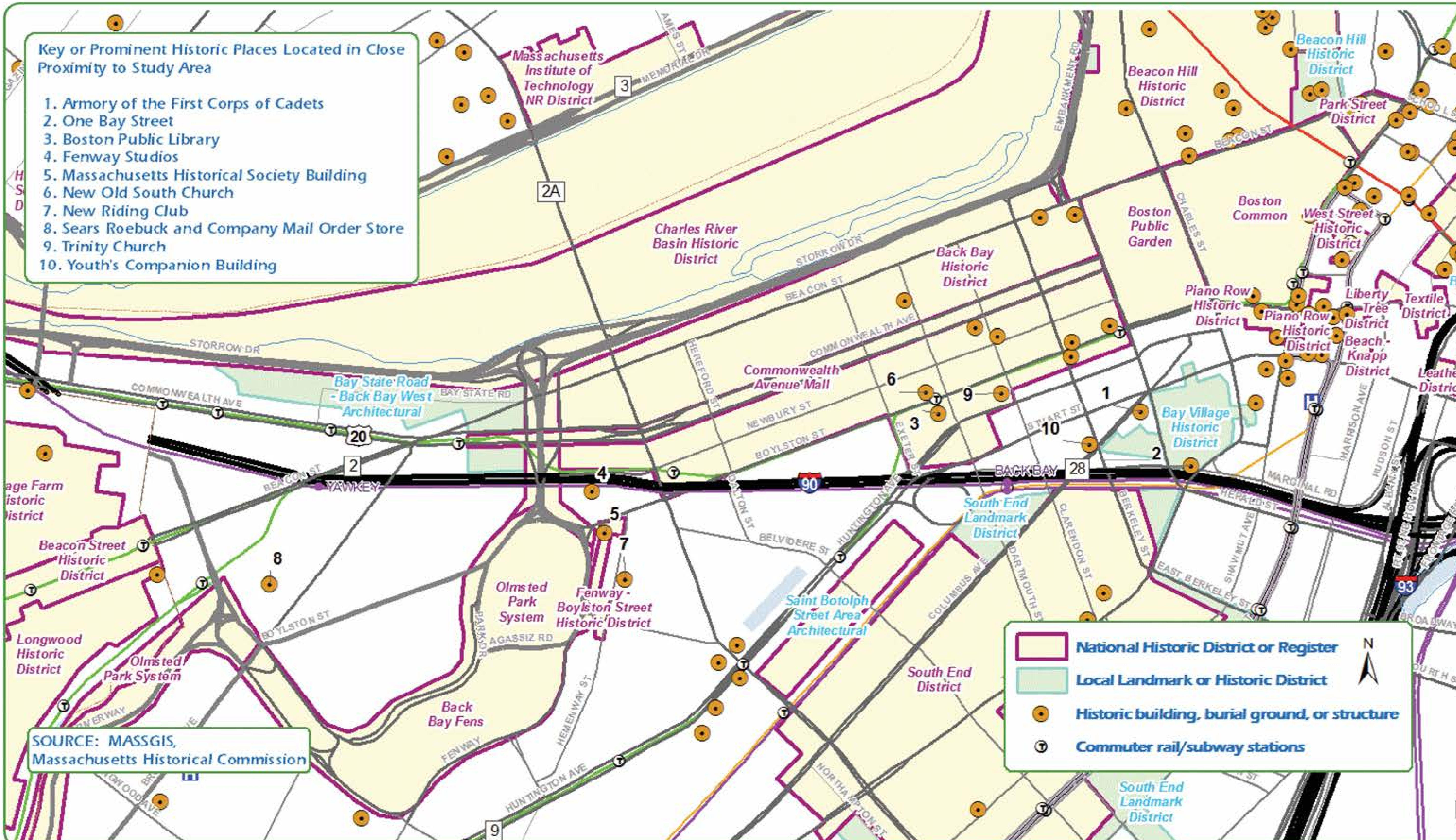



**FIGURE 2-13**
**Back Bay Historic Districts**

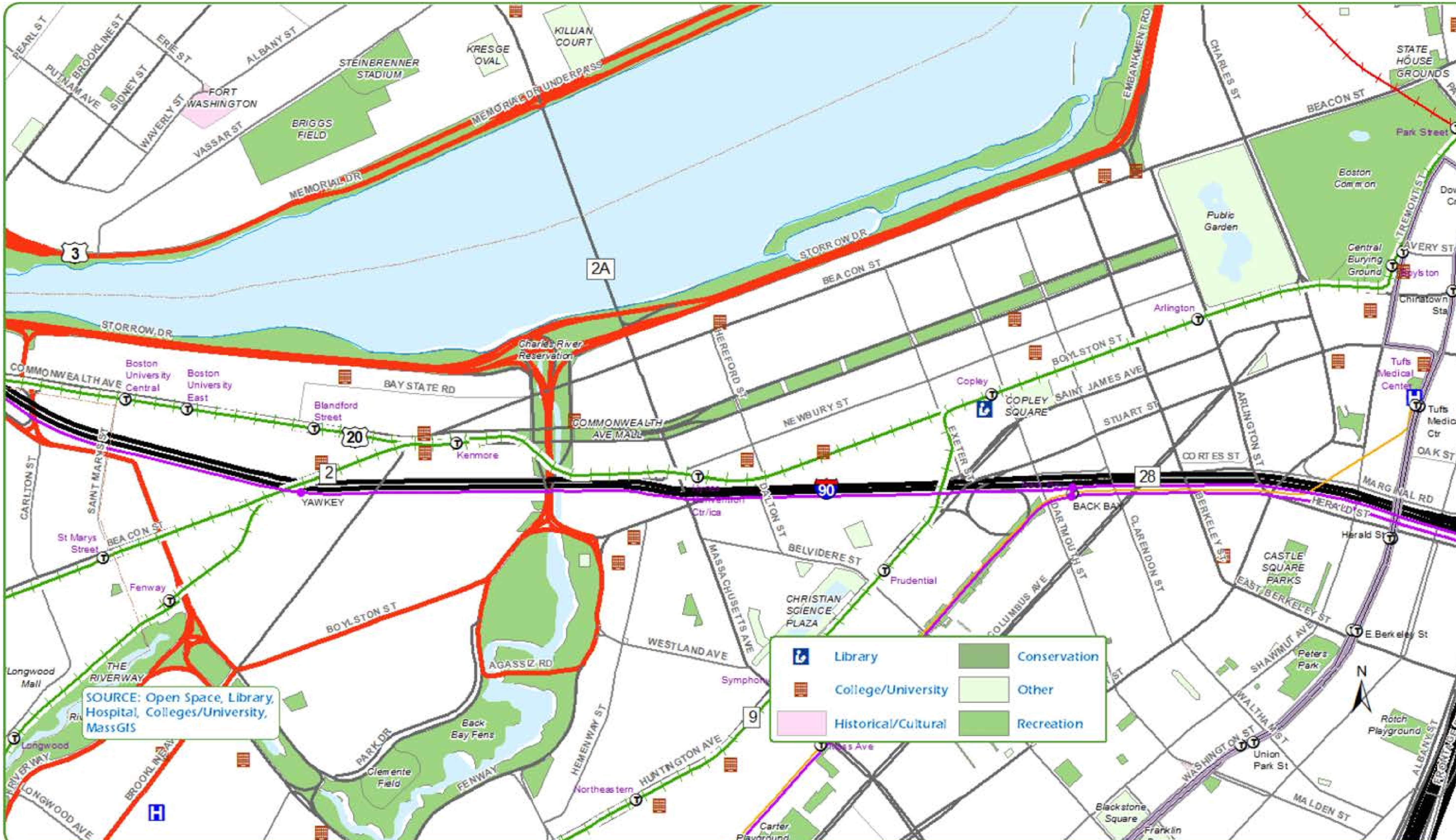



FIGURE 2-14
**Back Bay Parks and Open Spaces**

### 2.5.3 Terrain Constraints

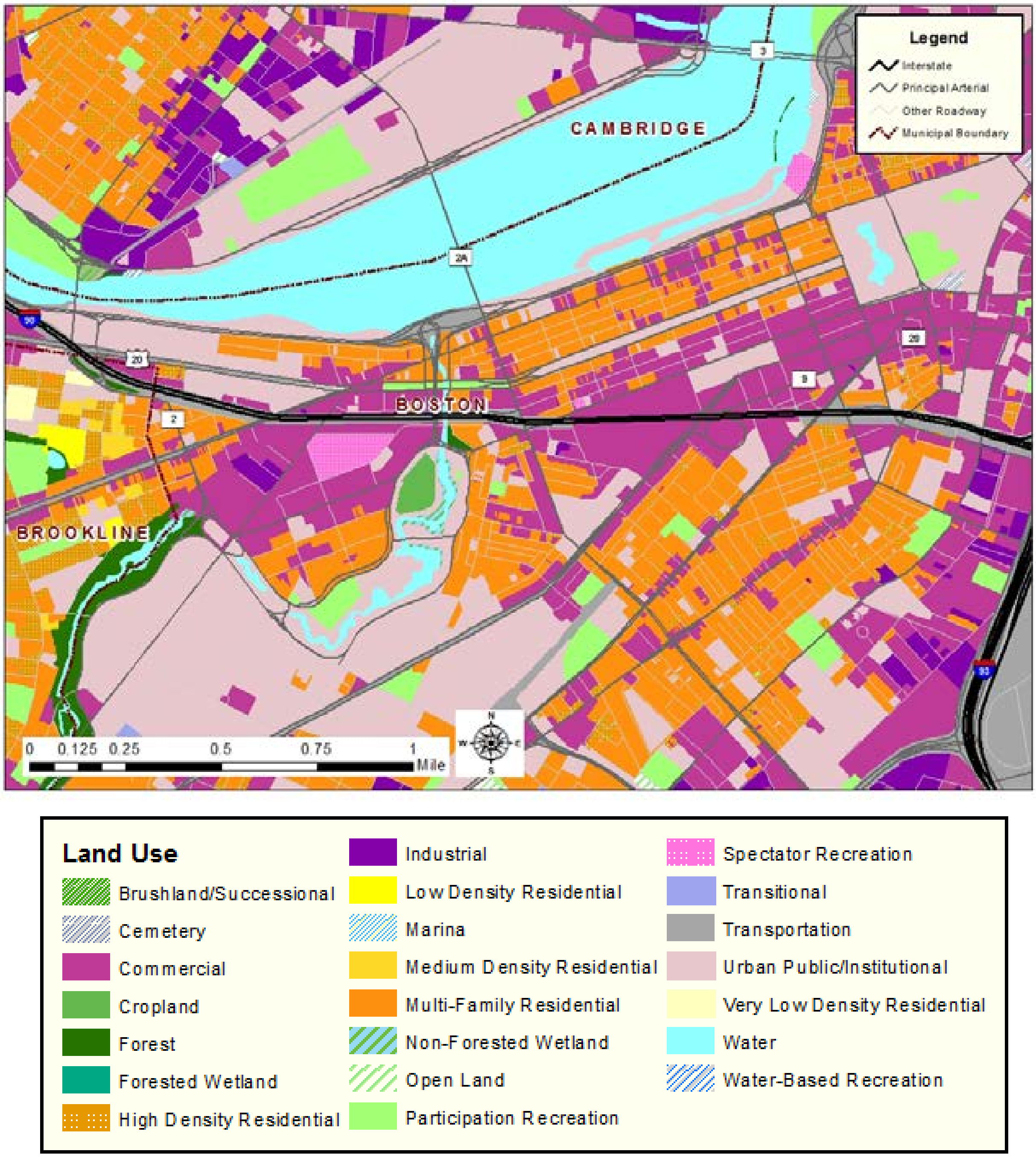
The study area is mostly level and ranges from nine to 29 feet above sea level. The maximum height is the land above the Massachusetts Turnpike as it travels through the Prudential Tunnel.

## 2.6 LAND USE

The primary land use in the study area is commercial, followed by residential, urban institutional, and recreational land uses. Other uses, such as open space and transportation, are scattered throughout the study area. The land use data are shown in Figure 2-15 and includes 22 categories of existing conditions.

The Massachusetts Turnpike is bordered primarily by commercial, residential, and urban institutional land uses. The urban institutional use along the Turnpike is the Boston University campus, and the commercial areas along the Turnpike are in the Fenway, Back Bay, and Chinatown business districts. The residential land uses are located near Audubon Circle in Brookline, in the Back Bay near Massachusetts Avenue, in Bay Village, in Chinatown, and along the northern edge of the South End.

**Figure 2-15**
**Land Use in the Study Area**




## 2.6.1 Massachusetts Turnpike Air Rights

In addition to the land uses on either side of the Turnpike, the air space above the highway is organized in parcels numbered sequentially from 1 through 23 (Figure 2-16). These parcels are located from just west of the Commonwealth Avenue

overpass to the I-93 overpass. Since the area above the Prudential Tunnel is owned by the Prudential Insurance Company, no parcel numbers were assigned to that area, causing a small gap in the air rights parcels between numbers 15 and 16.

Before the Massachusetts Turnpike Authority (MTA)[8] solicited bids for the development of the Prudential Insurance Company parcels, the City of Boston spearheaded an effort to develop a plan for the air rights area. The plan, entitled "The Civic Vision for Turnpike Air Rights in Boston," was completed in 2000 and adopted in 2001 by the City of Boston and the MTA, with the goal of guiding the development for each parcel or group of parcels, including the unnumbered parcel owned by the Prudential Insurance Company. Since the adoption of the air-rights plan, MassDOT has solicited proposals, and developers have responded by submitting plans for various parcels (Figure 2-17). Table 2-22 provides a summary of the status of each parcel.

The existing Copley Place and Hancock Garage (next to Back Bay Station) properties each feature preliminary plans for high-rise expansions. The Copley Place expansion would include expanded retail and residential uses. The construction drawings for the proposal were under review as of August 2015. The Hancock Garage owners recently executed a new lease that allows for future development of up to three high-rise buildings, which are anticipated to feature retail, office, and residential uses, as well as modifications to the existing garage.

[8] Before the consolidation of Massachusetts transportation agencies in November 2009, the MTA was an independent authority.

**Figure 2-16**
**Massachusetts Turnpike Air-Rights Parcels in the Study Area**

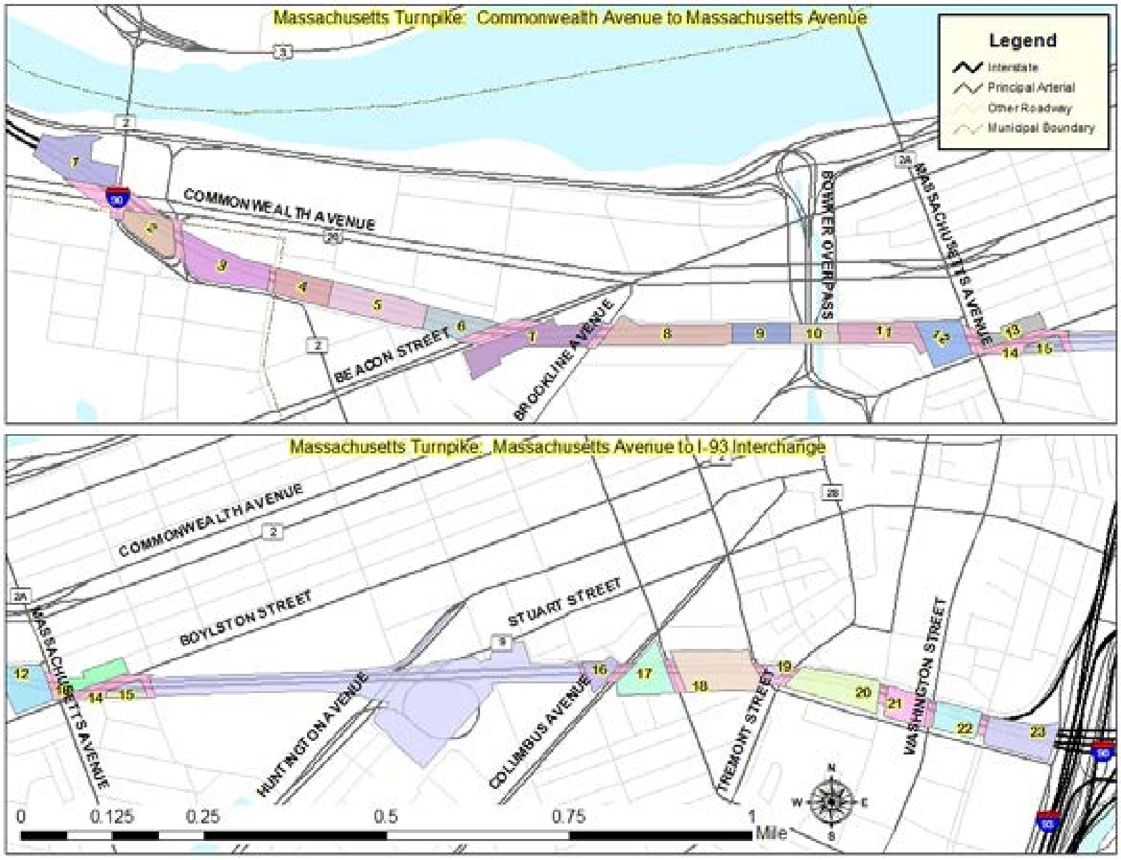
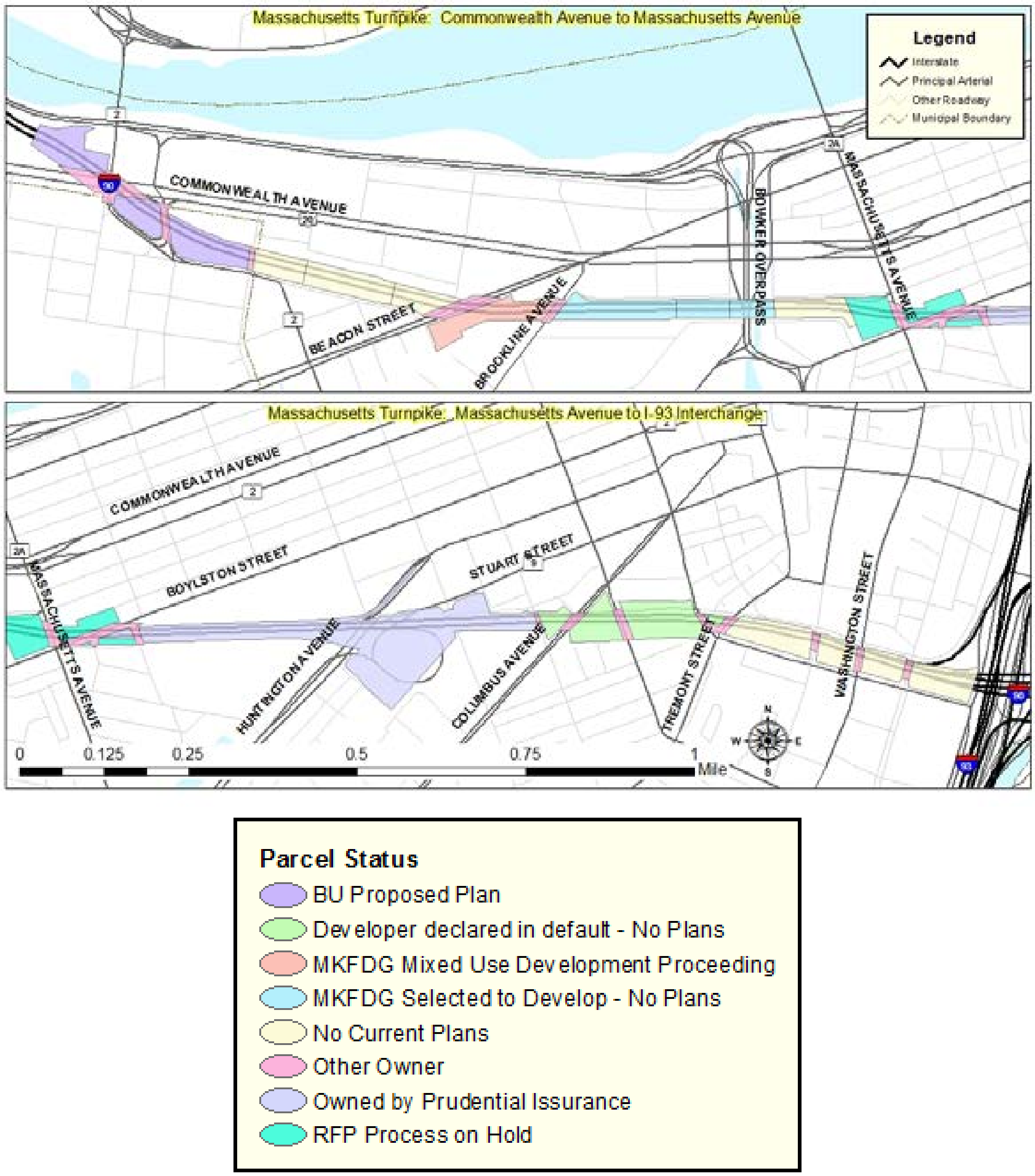


**Table 2-22**
**Proposed Air-Rights Developments**

| Parcel Number | Status | Proposed Land Use |
|---|---|---|
| Parcels 1-3 | Boston University proposed plan; no disposition or current activity | Education |
| Parcels 4-6 | No current plans | |
| Parcel 7 | Meredith Kenmore/Fenway Development Group mixed use; awaiting developer action | Residential, Commercial, Retail, and |
| Parcels 8-10 | Meredith Kenmore/Fenway Development Group selected to develop; disposition discontinued; no current activity | Parking |
| Parcel 11 | Unlikely to be developed | |
| Parcels 12 & 15 | Weiner-Samuels selected and under agreement | |
| Parcel 13 | The Peebles Corporation designated as developer; negotiations underway | Residential, Retail, Hotel, and Parking |
| Parcel 14 | Undevelopable independently | Residential, Retail, Hotel, and Parking; |
| Parcels 16-19 | No current plans | Hynes Station rehabilitation |
| Parcels 20-23 | No current plans | |

**Figure 2-17**
**Proposed Use of Massachusetts Turnpike Air-Right Parcels in the Study Area**




## 2.6.2 Other Development Proposals

In addition to the air-rights parcels, the City of Boston is reviewing proposed developments for other areas near the Massachusetts Turnpike. As required by Article 80 of the Boston Zoning Code, the Boston Redevelopment Authority (BRA) must follow a public review process.

Numerous developments that require a BRA review are located in the four main neighborhoods covered by this study: Fenway, Longwood Medical Area, Back Bay, and the South Boston Waterfront. The developments range from around 50,000 to more than 1,500,000 square feet. The South Boston Waterfront has the greatest number of proposed developments in the study area with more than a dozen, more than seven of which would be larger than 650,000 square feet. The impacts of future proposed developments on vehicular movements in the study area were estimated using the Boston Region MPO's regional travel demand computer model. Figure 2-18 shows the proposed developments in the study area.

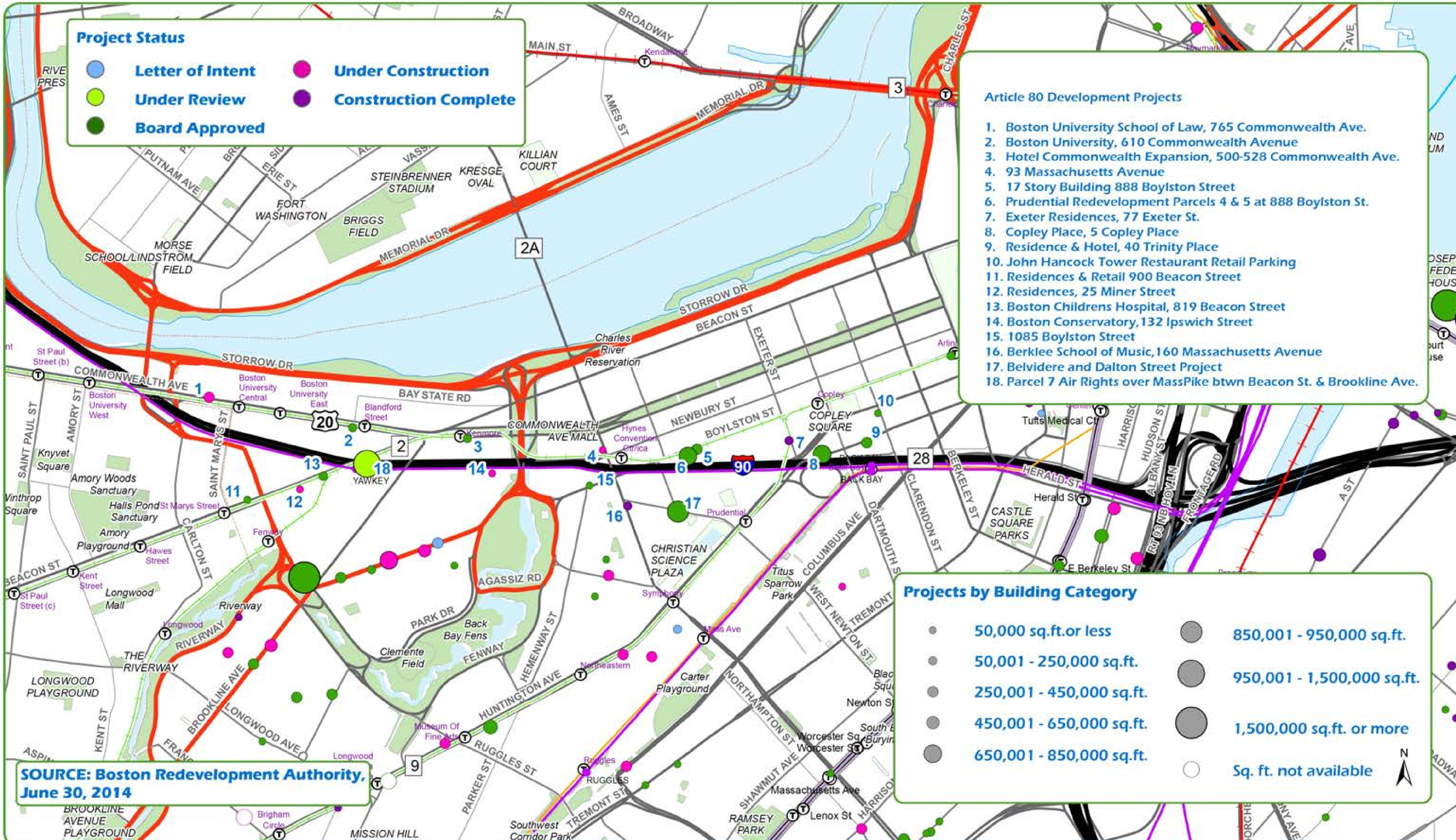



**FIGURE 2-18**
**Back Bay BRA Projects**

# Chapter 3—Existing Conditions: Bowker Overpass

## 3.1 INTRODUCTION

This chapter describes the analysis of the Bowker Overpass sub-area of the Massachusetts Turnpike – Boston Ramps Study. As in Chapter 2, which discusses the larger study area, this section summarizes existing transportation conditions during a typical workday, emphasizing the peak-commuting hour. This section also reviews crash data and land use conditions. The Transit Data and Environmental Conditions provided in Chapter 2 apply to the Bowker Overpass sub-area of the study.

## 3.2 TRAFFIC CONDITIONS

Developing a base knowledge of current traffic conditions fosters an understanding of where congestion occurs now and where it likely would occur in the future. The first step in calculating traffic congestion requires using current or recent turning-movement and traffic counts. Traffic counts were obtained along the Massachusetts Turnpike between the Allston Tolls and Ted Williams Tunnel, and at specific intersections throughout the study area. The volumes used in this analysis are presented in Section 3.2.1. Section 3.2.2 summarizes system performance.

### 3.2.1 Existing (2010) Traffic Volumes

The Bowker Overpass delineates the Back Bay and Fenway/Kenmore neighborhoods, and runs roughly along the Muddy Brook between the Emerald Necklace/Back Bay Fens and the Charles River Esplanade. It connects Boylston Street and Fenway with Storrow Drive over the Massachusetts Turnpike, Commonwealth Avenue, and Beacon Street (Figure 3-1). The Bowker is also known as the Charlesgate Overpass, as Charlesgate is the name of the roadway that the overpass carries. On either side of the Bowker, Charlesgate East and Charlesgate West provide at-grade access to Commonwealth Avenue and Beacon Street. This study sub-area includes 13 study intersections between Kenmore Square to the west and Stuart Street at Arlington Street to the east (Figure 3-2 and Table 3-1). Those intersections not directly along the Charlesgate corridor were included to assess the impact of proposed alternatives elsewhere in the Back Bay area.

The overpass is roughly 1,600 feet long with two travel lanes in each direction. It is a limited-access roadway divided by a six-foot wide curbed median with a guardrail. There are off- and on-ramps for access to/from eastbound Commonwealth Avenue and both directions of Storrow Drive. As the Bowker descends at the north end, the roadway passes under eastbound Storrow Drive.

As shown in Figure 3-3, most of the roads in the area are owned and operated by the City of Boston. However, the Department of Conservation and Recreation (DCR) is responsible for Charlesgate, Charlesgate East, Charlesgate West, Storrow Drive, and a portion of Boylston Street.

**Table 3-1**
**Bowker Overpass Study Intersections/Count Locations**

1. Charlesgate at Boylston Street and Fenway
2. Charlesgate East at Commonwealth Avenue – Eastbound
3. Charlesgate East at Commonwealth Avenue – Westbound
4. Charlesgate West at Commonwealth Avenue – Eastbound
5. Charlesgate West at Commonwealth Avenue – Westbound
6. Charlesgate East at Beacon Street
7. Charlesgate West at Beacon Street
8. Charlesgate East at Marlborough Street
9. Saint James Avenue at Dartmouth Street
10. Stuart Street at Arlington Street
11. Kenmore Square
12. Bowker Overpass at Boylston Street
13. Beacon Street at Massachusetts Avenue

The Bowker Overpass, its on- and off-ramps, and its bridge structures are owned by MassDOT. The roadways leading to the Bowker Overpass are owned by DCR and, along with the Bowker Overpass, are functionally classified as principal arterials. Although it is part of the National Highway System (NHS), there is a truck restriction in place, as there is on many of DCR's parkways and roadways. The travel lanes are approximately 16-feet wide and there are no shoulders. There are sidewalks on either side of the overpass south of the Commonwealth Avenue ramps.

Charlesgate East and West also are DCR-owned principal arterials. As full-access roadways, they permit trucks; however, they are not designated truck routes, nor part of the NHS. Each roadway travels in one direction—northbound traffic runs on Charlesgate East (generally in two lanes), and southbound traffic on Charlesgate West (generally three lanes). There is no on-street parking, and there are sidewalks on both sides. Bicyclists on these sections ride with traffic or on the sidewalk; there is no on-road bicycle infrastructure.

Storrow Drive is a limited-access roadway owned by DCR and functionally classified as a principal arterial. Trucks are not allowed on it. It has two 12-foot wide lanes in each direction and is divided by a 12-foot wide median. There are three-foot wide shoulders on either side. The Dr. Paul Dudley White/Charles River Path parallels Storrow Drive on the north side for bicycles, pedestrians, and other nonmotorized users.

Beacon Street is one way westbound, with full access. It is a principal arterial owned by the City of Boston, but it is not part of the NHS. Parallel parking is permitted on both

**Figure 3-1**
**Bowker Overpass Area**

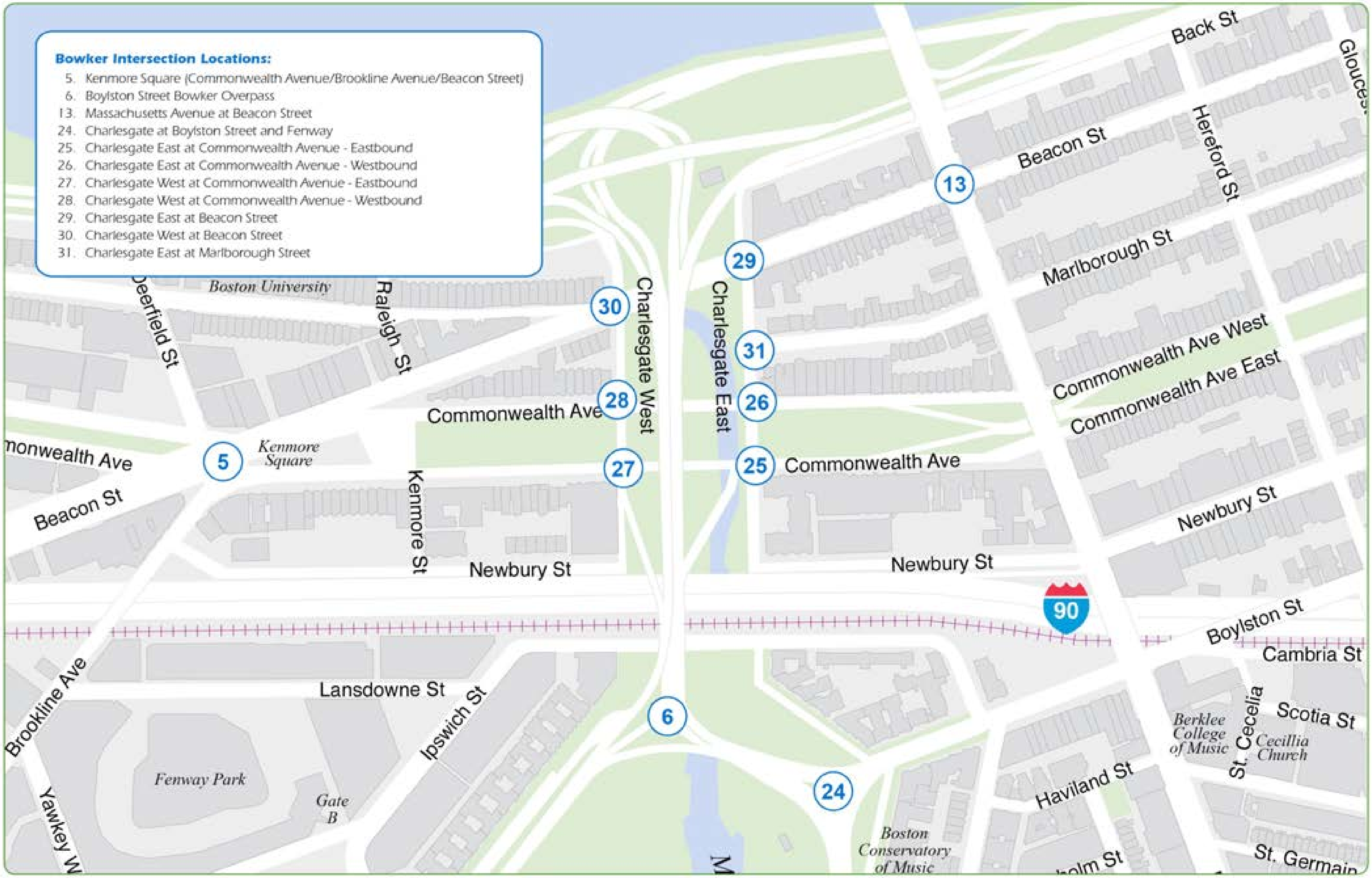



FIGURE 3-2
Bowker Overpass Study Intersections

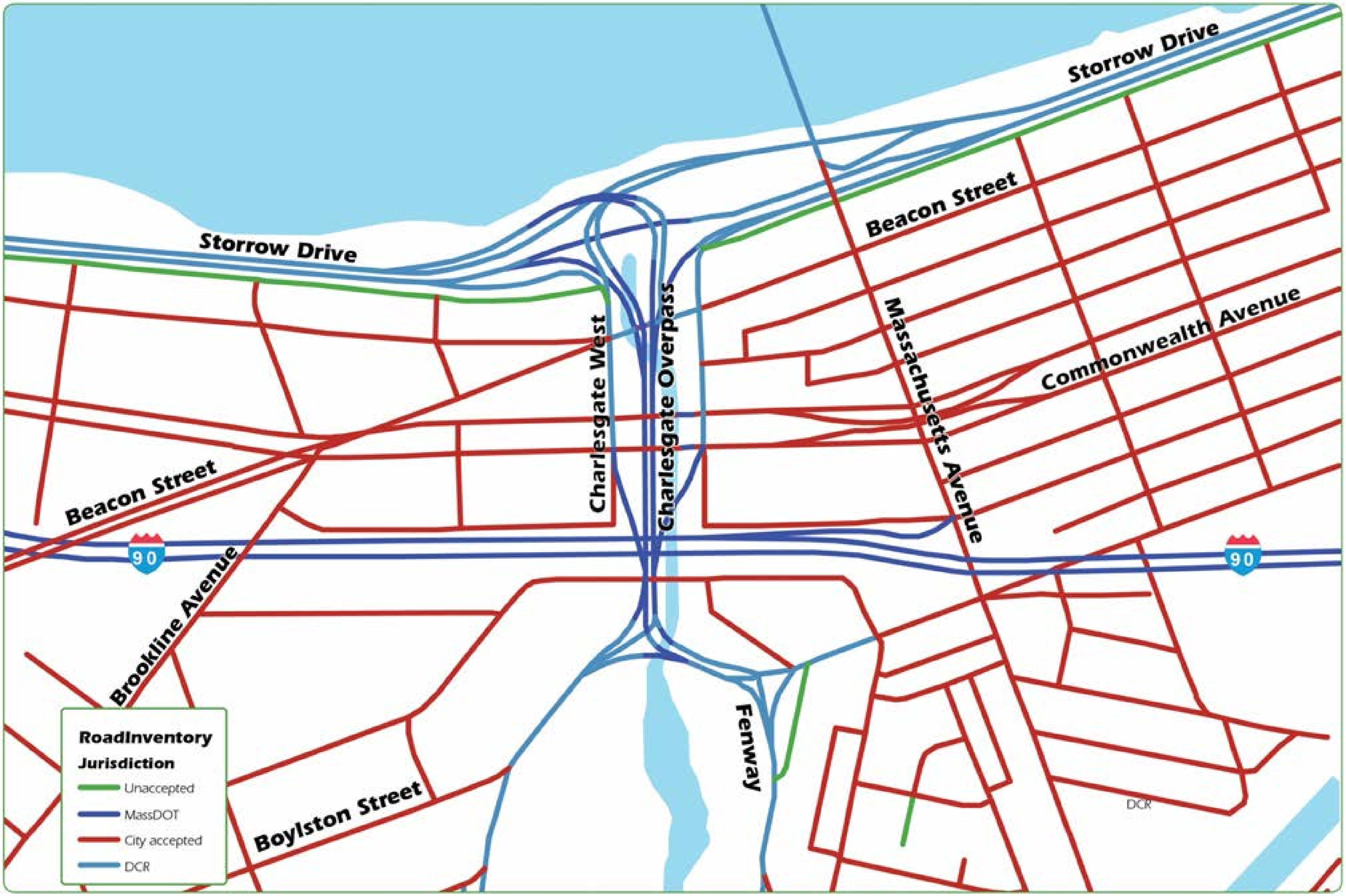



**FIGURE 3-3**
**Roadway Jurisdiction**

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Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

sides and there is a six-foot wide bike lane along the north side. The two travel lanes are approximately 11.5 feet wide each, with sidewalks on both sides.

Commonwealth Avenue (also Route 2) is a City-of Boston-owned principal arterial, classified as a full access roadway, and part of the NHS. East of Charlesgate, Commonwealth Avenue has two lanes in each direction and is divided by a 96-foot-wide median, where pedestrians can enjoy a park-like atmosphere. There are six-foot-wide bicycle lanes along the inner (median) sides and bicycle sharrows (pavement markings) in the outer travel lanes, as well as parallel parking and sidewalks. The travel lanes are approximately 10-feet wide. West of Charlesgate, the cross section varies through Kenmore Square.

Boylston Street is a principal arterial with portions owned by DCR, the city of Boston, and MassDOT. It generally has a straight alignment except where it skirts the Emerald Necklace at the southern end of the Bowker Overpass. It has two travel lanes in each direction, and the Emerald Necklace path runs along the south side for pedestrians and bicyclists. Boylston Street is part of the NHS and trucks are allowed on it. There is no parking along this section. There are no on-road bicycle facilities. West of the overpass between Charlesgate and Park Drive, the 40-foot wide surface is undivided and there is a frontage road on the northwestern side. Although there is no sidewalk between the frontage road and Boylston Street, there is a pedestrian desire line, as evidenced by a path worn in the grass. East of the overpass between Charlesgate and Fenway, the 64-foot wide surface is divided by an 18-foot median, where there is a sidewalk on the north side.

For bicyclists, the Bowker Overpass presents a significant gap in the regional network. Two of Boston's most important off-road facilities, the Emerald Necklace and the Charles River Path, are isolated from each other because of the lack of an off-street connection (Figure 3-4). The Muddy Brook and the open space surrounding it present a natural linkage between these two major public areas. Efforts currently are proposed to help fill this gap. The Charlesgate Greenway Connection project seeks to re-open a two-acre parcel of parkland within the Storrow Drive median that presently is cut off from its surroundings. The project would provide a multi-use connection between Beacon Street and Massachusetts Avenue. This effort is currently in the design phase.

The MBTA Green Line runs under Charlesgate with stops at Hynes Convention Center to the east and Kenmore to the west. There is a commuter rail stop at Yawkey Way on the Worcester line. Table 3-2 lists the bus routes in the area.

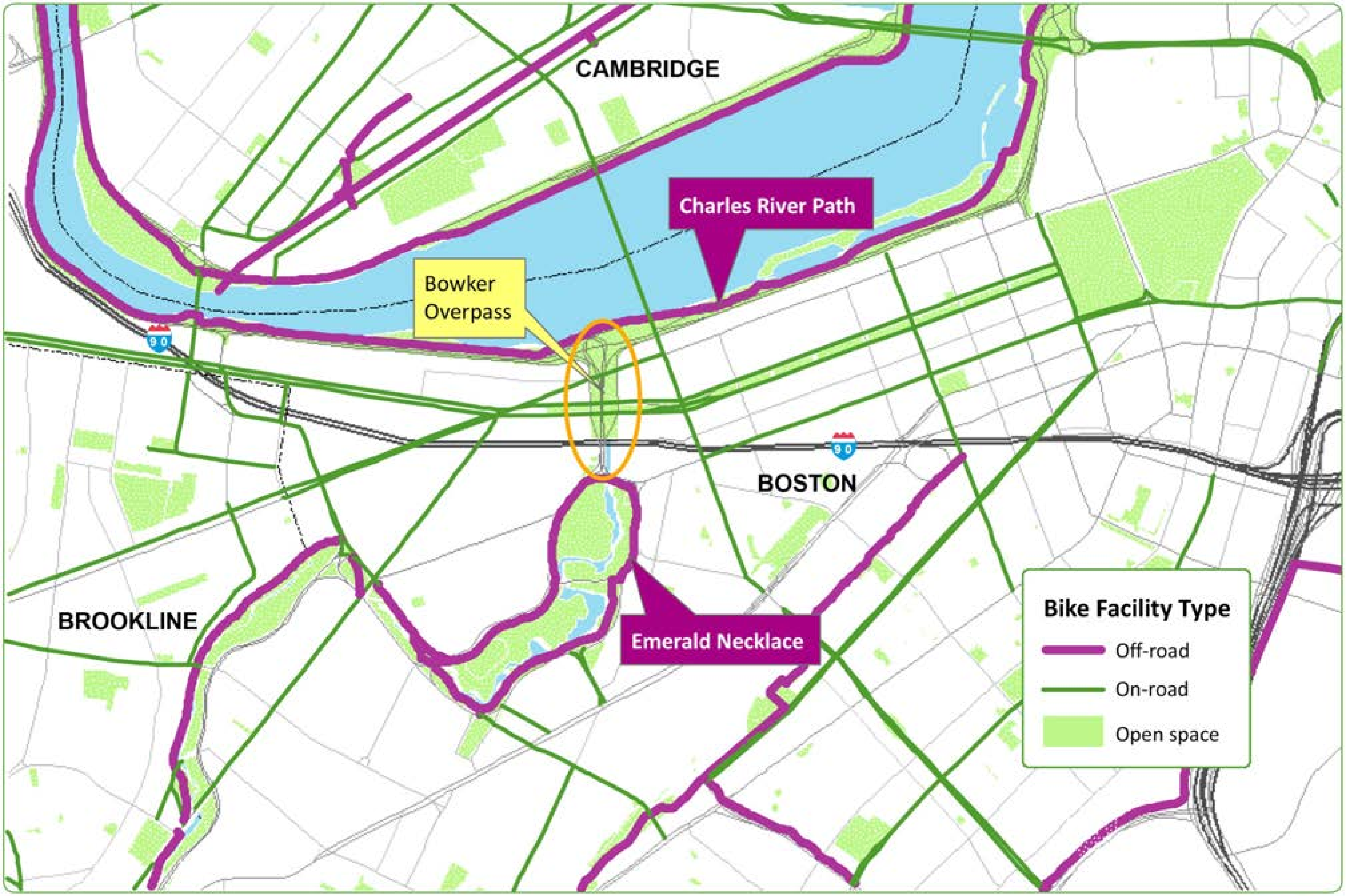


**FIGURE 3-4**
**Gap Between Charles River Path and Emerald Necklace**

**Table 3-2**
**Bowker Overpass Study Area Bus Routes**

| |
|---|
| Bus 1: Harvard/Holyoke Gate — Dudley Station |
| Express Bus 170: Central Square, Waltham and Dudley Square |
| Bus 19: Fields Corner Station — Kenmore or Ruggles Station via Grove Hall and Dudley Station |
| Bus 39: Forest Hills Station — Back Bay Station via Huntington Ave |
| Bus 55: Jersey and Queensberry — Copley Square or Park and Tremont Streets via Ipswich Street |
| Bus 57: Watertown Yard — Kenmore Station via Newton Corner and Brighton Center |
| Bus 60: Chestnut Hill — Kenmore Station via Brookline Village and Cypress Street |
| Bus 65: Brighton Center — Kenmore Station via Washington Street, Brookline Village, and Brookline Avenue |
| Bus 8: Harbor Point/UMass — Kenmore Station via BU Medical Center and Dudley Station |
| Bus 9: City Point - Copley Square via Broadway Station |
| Bus CT1: Central Square, Cambridge — BU Medical Center/Boston Medical Center via MIT |
| Express Bus 170: Central Square, Waltham and Dudley Square |
| Bus 19: Fields Corner Station — Kenmore or Ruggles Station via Grove Hall and Dudley Station |

### 3.2.2 Intersection Volumes

The intersection counts for the Bowker study area were conducted in 2010; to ensure consistent counts seasonal adjustment factors were applied to them so they would reflect an average weekday peak period volume. Figure 3-5 shows the AM (7:00 AM–9:00 AM) and PM (4:00 PM–6:00 PM) peak volumes in the Bowker study area.

Site visits conducted by the project team found that there were more than 8,000 bicycle and pedestrian users of roads surrounding the Bowker Overpass in September 2013. Although many of these movements were east-west, more than 20 percent of these users accessed the area from Boylston Street to the south (despite poor travel conditions for bicyclists and pedestrians in the north-south direction). Improving safety conditions could result in a substantial increase of bicycle and pedestrian travel in this area.

### 3.2.3 Intersection Analysis

Using the data collected for the AM and PM peak periods, staff utilized SYNCHRO to assess the capacity and quality of traffic flow at the intersections. The analyses were conducted consistent with the Highway Capacity Manual (HCM) methodology, which demonstrates the driving conditions at signalized and unsignalized intersections in terms of level-of-service (LOS) ratings from A through F. LOS A represents the best operating conditions (little-to-no delay), while LOS F represents the worst operating conditions (very long delay). LOS E represents operating

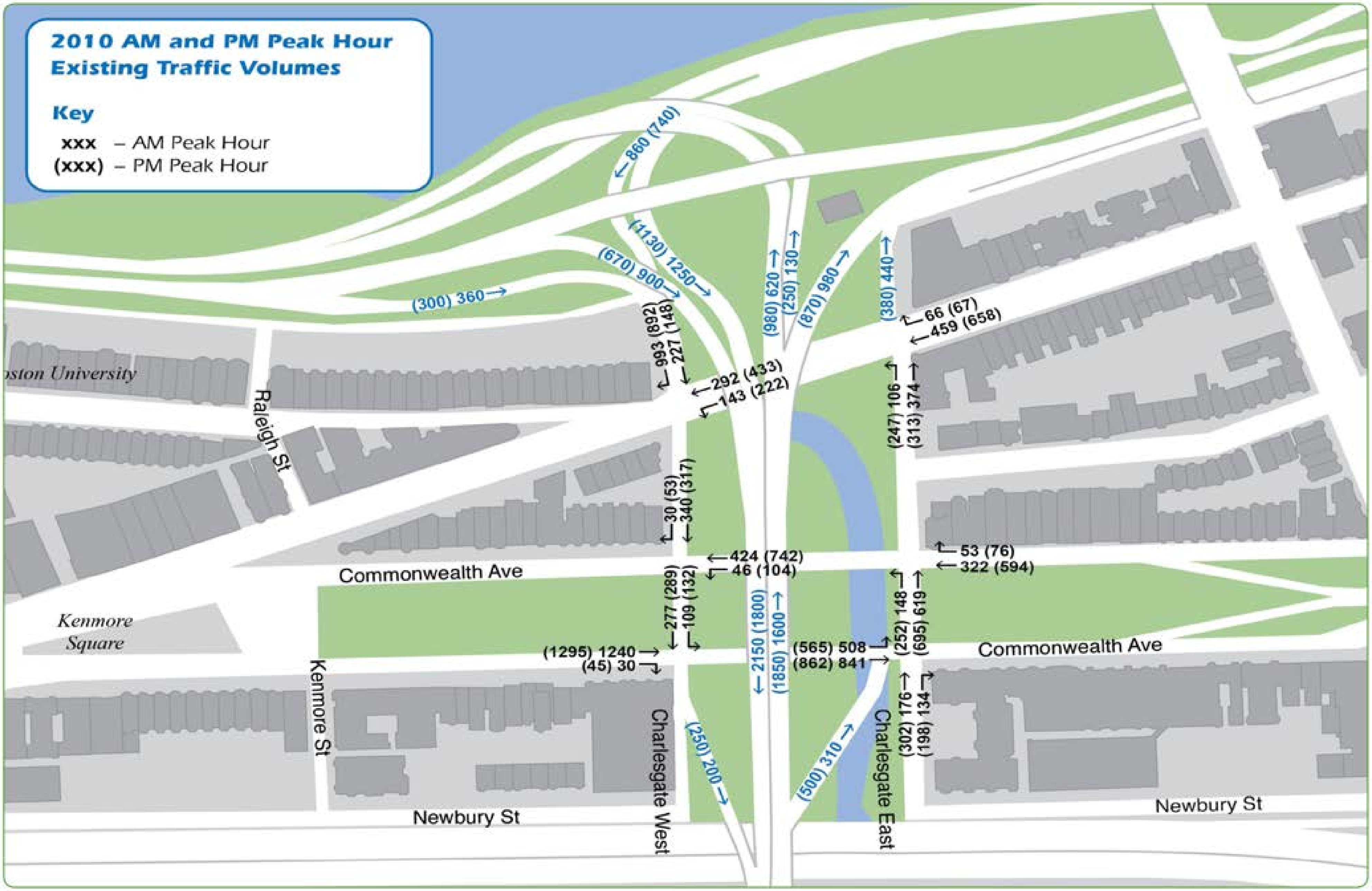


FIGURE 3-5
Peak Period Existing Volumes: Bowker Overpass

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Massachusetts Department of Transportation

conditions at capacity (limit of acceptable delay). Table 3-3 shows the control delays associated with each level of service for signalized and unsignalized intersections.

**TABLE 3-3**
**Level of Service Criteria**
**for Signalized Intersections**

| Level of Service | Control Delay (seconds per vehicle) |
|---|---|
| A | ≤ 10 |
| B | > 10-20 |
| C | > 20-35 |
| D | > 35-55 |
| E | > 55-80 |
| F | > 80 |

Figure 3-6 shows the AM and Figure 3-7 shows the PM peak-period existing LOS for each key intersection within the study area. Generally, the study area intersections operate better during the AM peak period than in the PM peak period. However, the Boylston-Charlesgate intersection immediately south of the Turnpike operates at LOS E during the AM peak period and LOS D during the PM peak period.

Bicycle and pedestrian LOS also was measured for the Bowker Overpass sub-area using a calculation provided by the League of Illinois Bicyclists and promoted by the National League of Cities Sustainable Cities Institute. The LOS measures include an evaluation of traffic volumes, on- and off-road bicycle and pedestrian infrastructure, lane widths (particularly of outside lanes), on-street parking, pavement conditions, and heavy-vehicle volumes to derive a grade of bicycle and pedestrian comfort along the same scale as a vehicular LOS. Figure 3-8 shows the bicycle and pedestrian level of service for corridors in the Bowker Overpass sub-area.

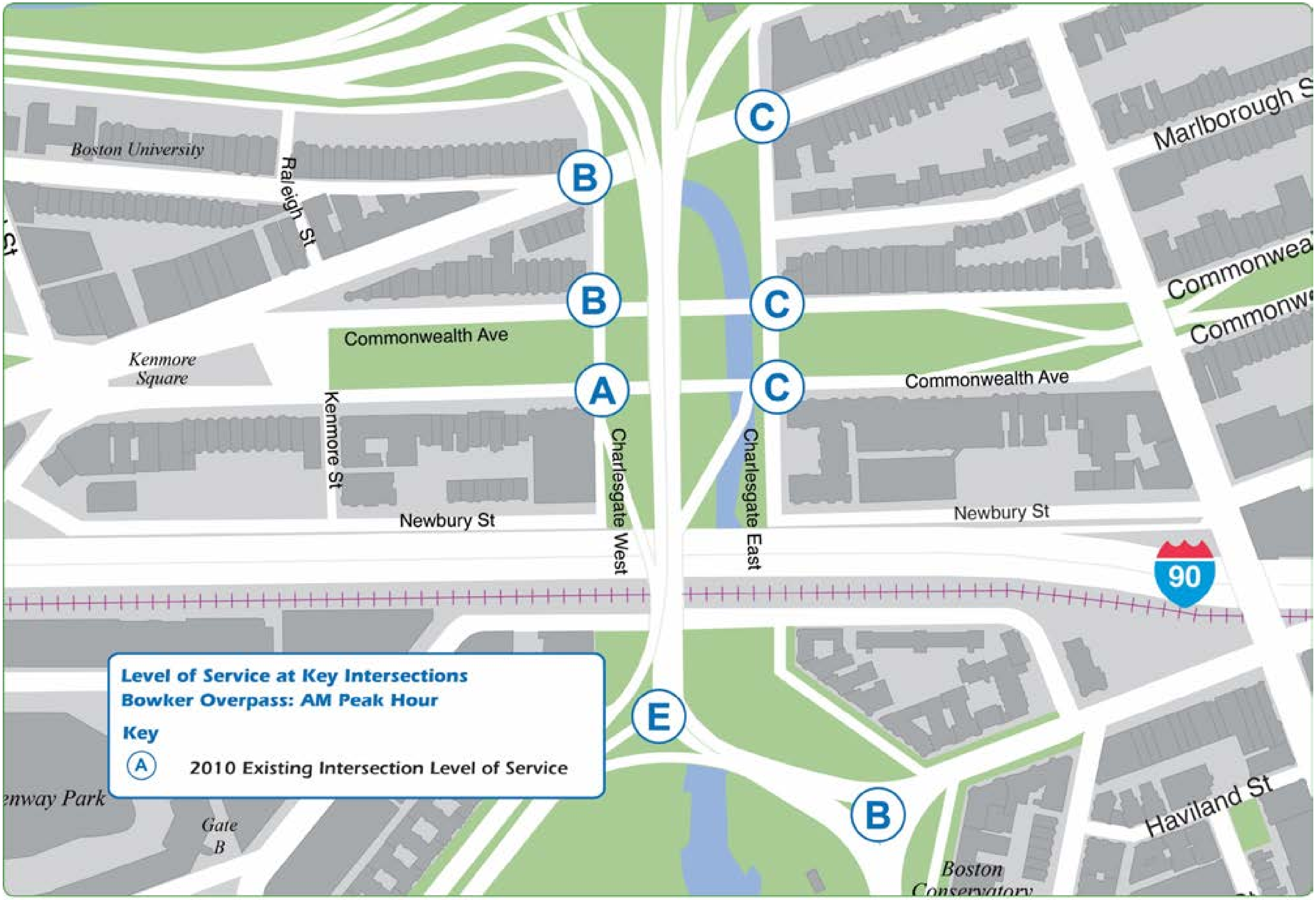


**FIGURE 3-6**
**AM Peak Period LOS Under Existing Volumes: Bowker Overpass**

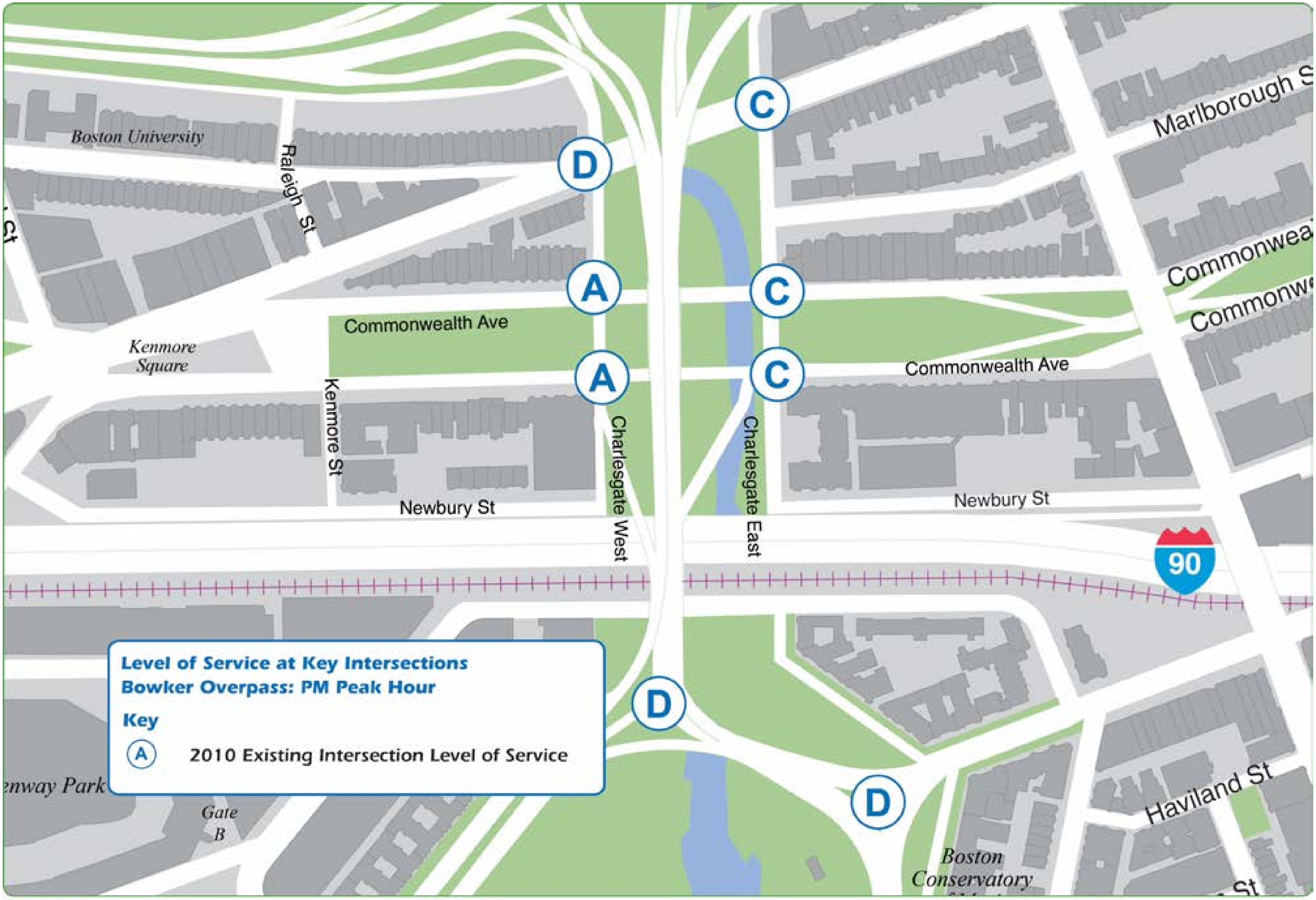


**FIGURE 3-7**
**PM Peak Period LOS Under Existing Volumes: Bowker Overpass**

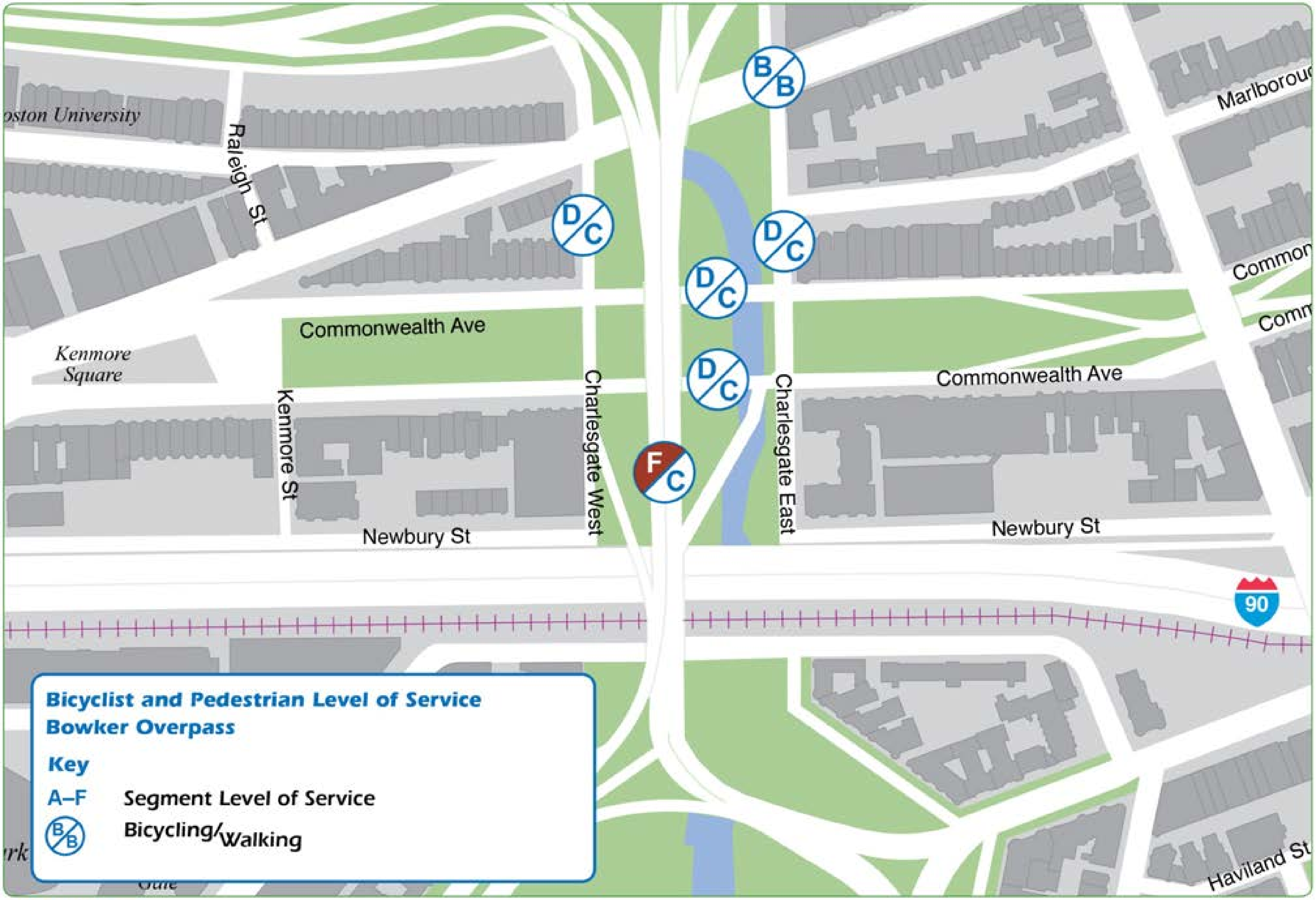


**FIGURE 3-8**
**Bicycle and Pedestrian Level of Service**
**Bowker Overpass**

## 3.3 CRASH DATA

The existing safety conditions within the Bowker Overpass study area were analyzed using crash report data for the 13 study intersections. The report database was created by the Registry of Motor Vehicles (RMV) using paper crash reports submitted by motorists involved in crashes. The following crash data is for the five-year period from 2006–10.

The MassDOT 2011 Top Crash Locations Report ranks Charlesgate West at Commonwealth Avenue as number 89 in the state (second in Boston) and Charlesgate East at Beacon Street as number 203 (fourth in Boston). Consistent with this, Figures 3-9 and 3-10 show that Charlesgate West at westbound Commonwealth Avenue and at Beacon Street and Charlesgate East at Beacon Street are the three study intersections with the most crashes.

While the majority of crash incidents involve property damage only, Charlesgate West at westbound Commonwealth Avenue and Charlesgate West at Beacon Street are the two intersections in the study area with the most personal injuries (Figure 3-11). The intersection of Beacon Street at Massachusetts Avenue has an equal number of crashes involving property damage only and injuries; and it has the most incidents involving bicyclists and pedestrians in the study area (Figure 3-12). St. James Avenue at Dartmouth Street is the only location in the study area with more injury than property-damage-only crashes. None of the crashes in the study area were fatal.

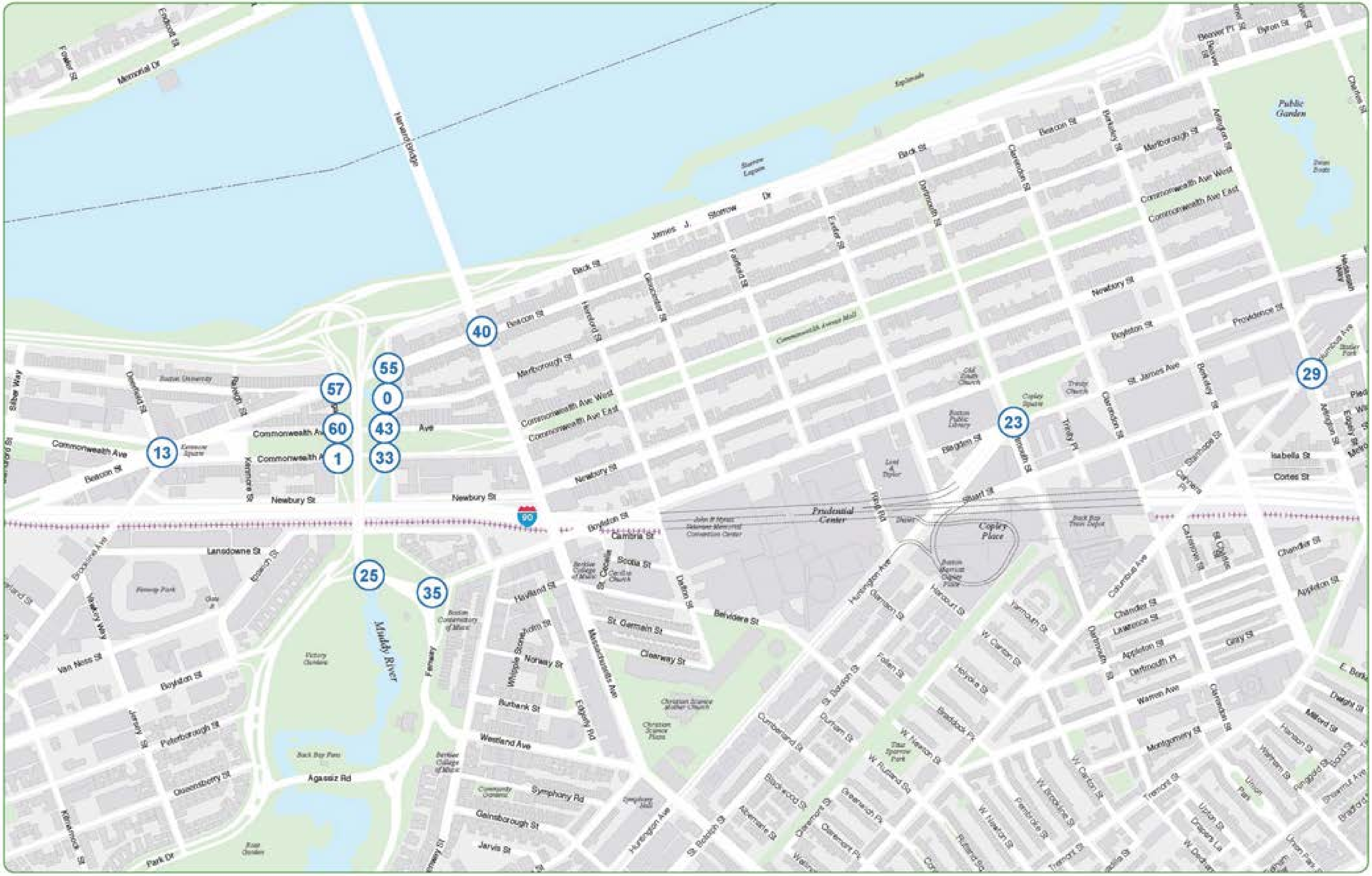


**FIGURE 3-9**
**Crashes by Intersection**

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Massachusetts Department of Transportation

**Figure 3-10**
**Total Crashes by Intersection**

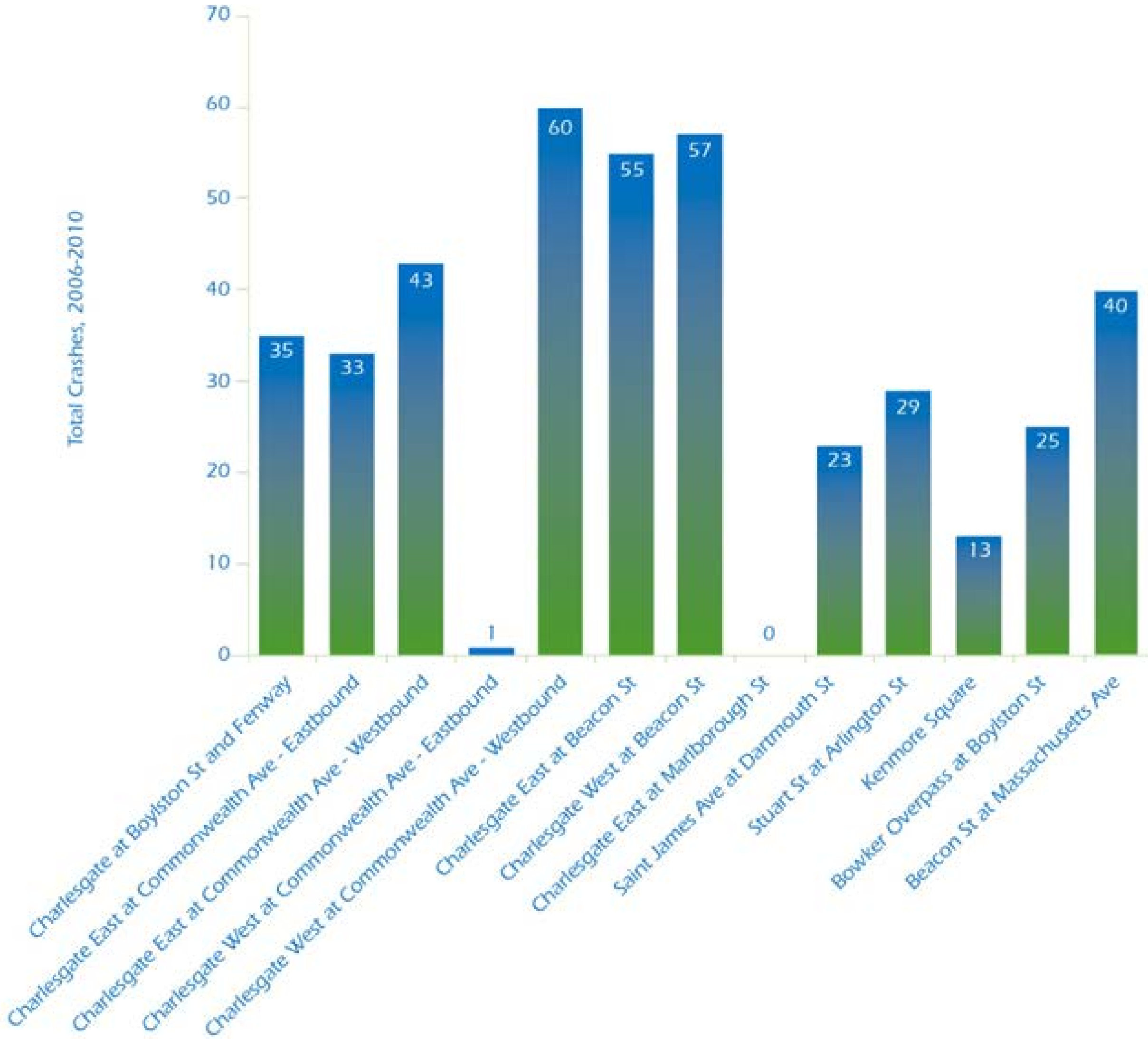


**Figure 3-11**
**Crash Severity by Intersection**

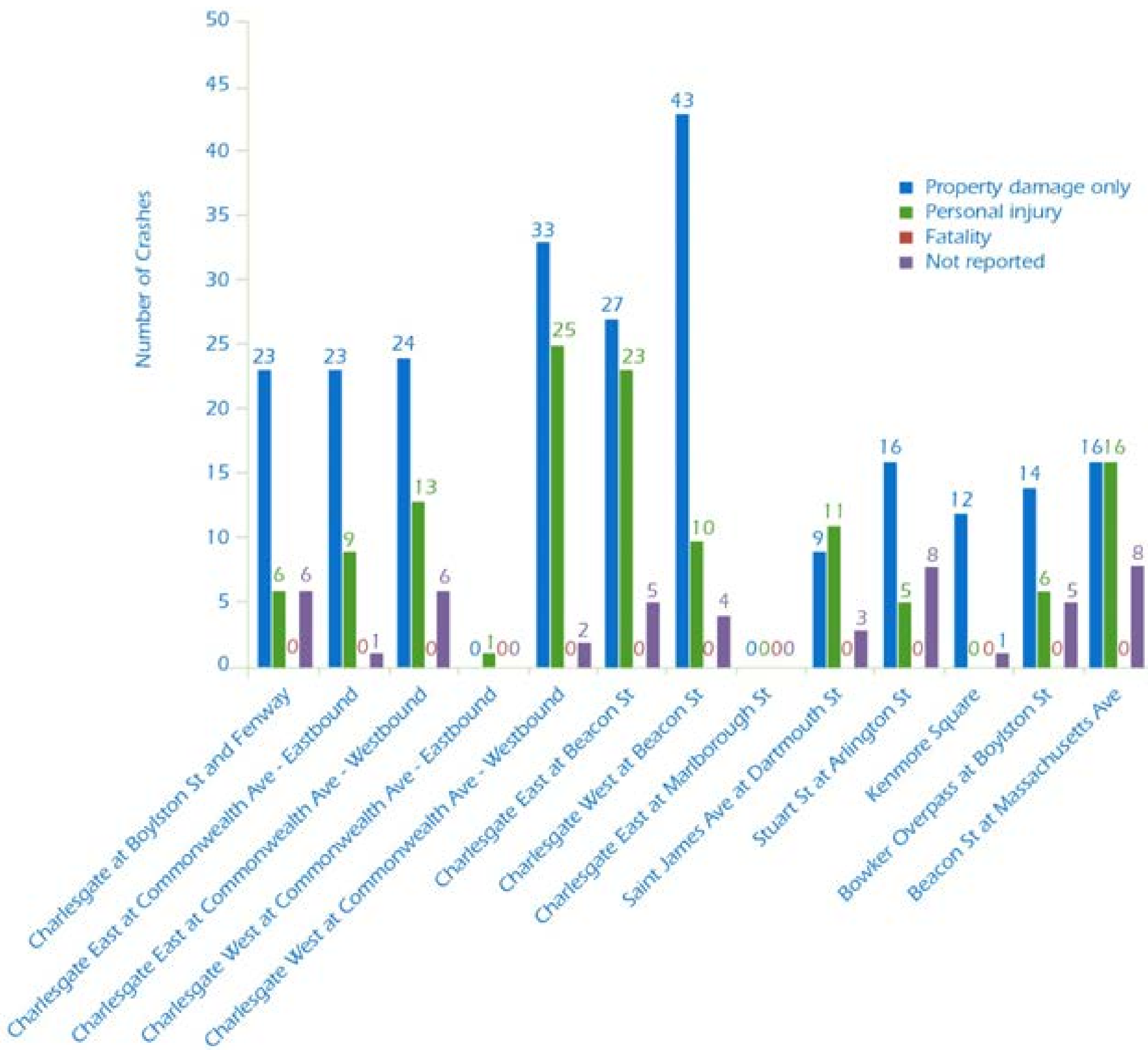


**Figure 3-12**
**Number of Crashes Involving Bicyclists or Pedestrians**

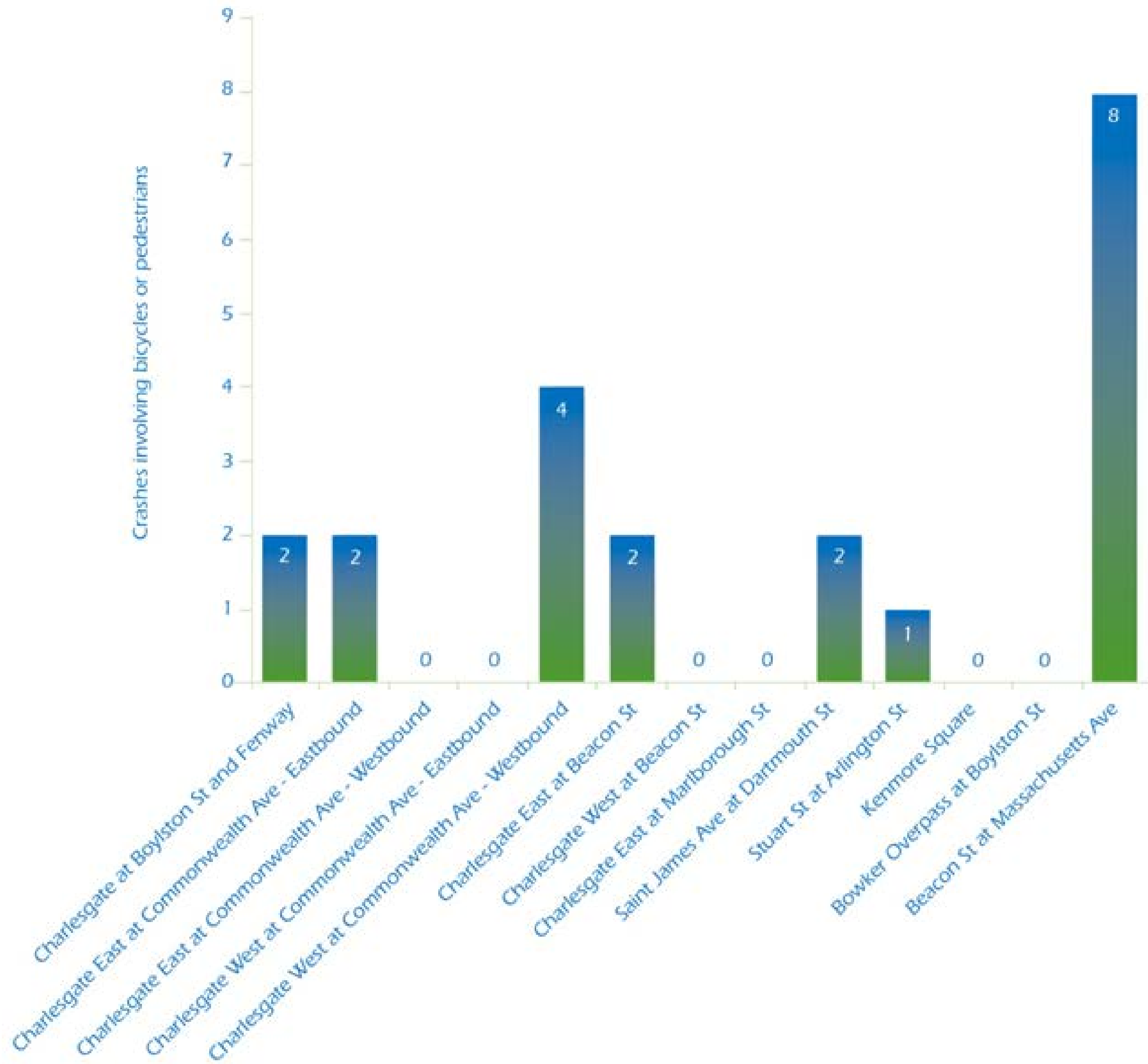


Figure 3-13 shows that the majority of crashes are angle type. However, at the Bowker Overpass at Boylston Street, Charlesgate at Boylston and Fenway, and Beacon Street at Massachusetts Avenue, rear-end crashes dominate. Sideswipes also occur frequently at nearly all the study intersections.

**Figure 3-13**
**Crash Type by Intersection**

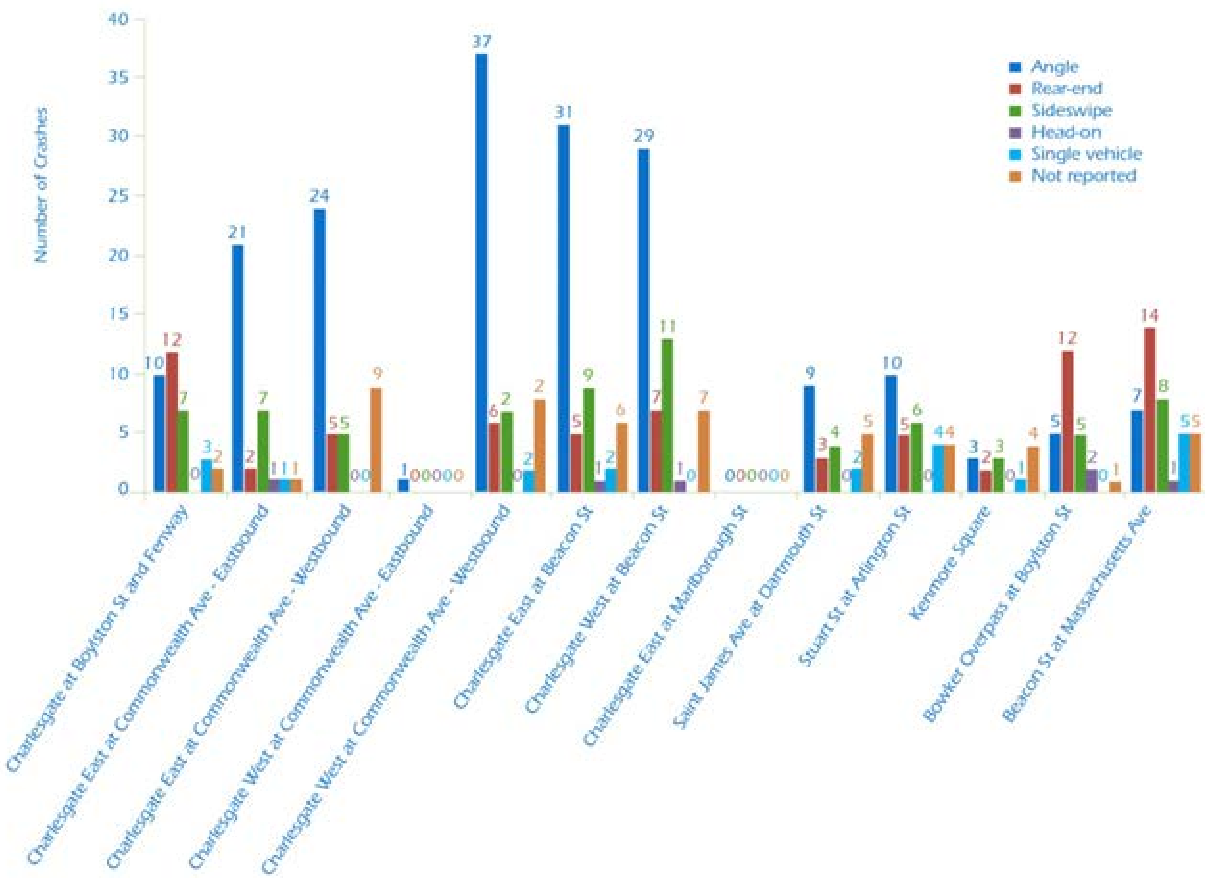


Figure 3-14 shows that weather does not appear to be a contributing factor to crashes at the study intersections. However, lighting conditions may be a factor at Beacon Street at Massachusetts Avenue and at both the Charlesgate East at Commonwealth Avenue-Eastbound and Charlesgate West at Commonwealth Avenue-Westbound intersections (Figure 3-15).

**Figure 3-14**
**Weather Conditions at Time of Crash**

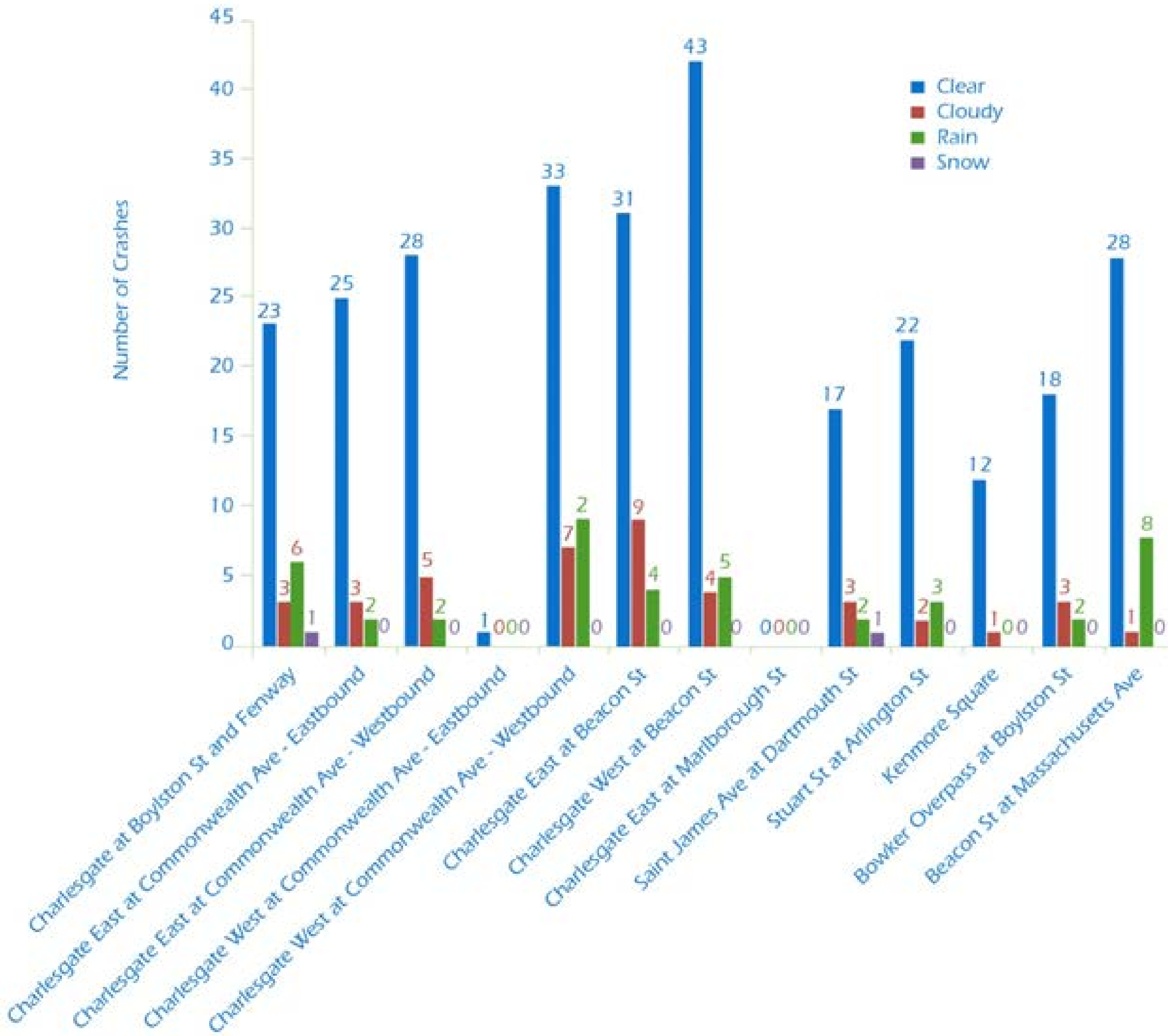
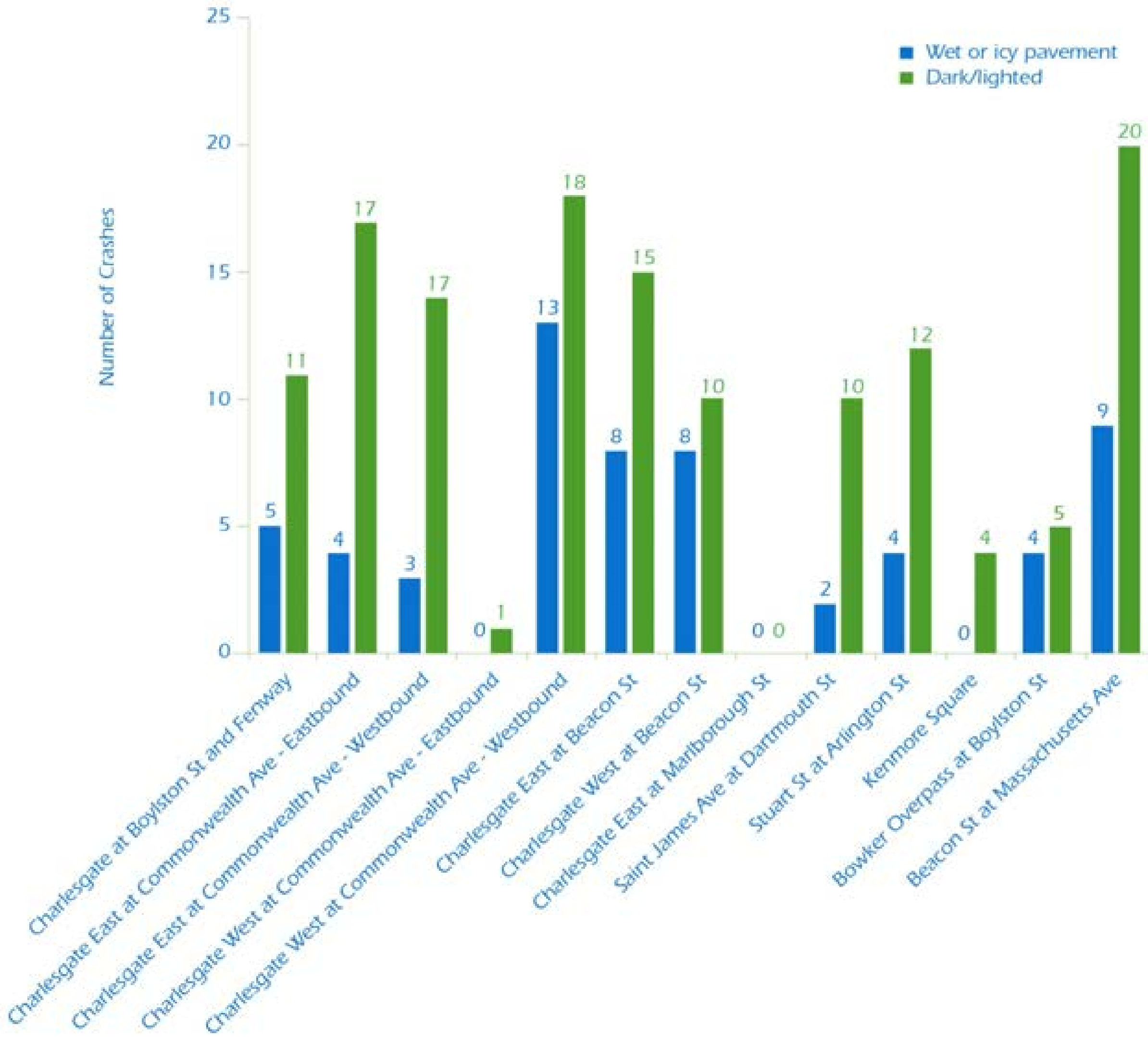


**Figure 3-15**
**Road Surface and Lighting Conditions**
**At Time of Crashes**




## 3.3.1 Intersection Crash Data

Crash data for the Bowker Overpass study intersections was gathered from the RMV database for the five-year period 2006 to 2010. This crash data provides an overview of safety conditions at key Bowker study area intersections and will be useful in assessing the potential effects of proposed alternatives.

### *Charlesgate at Bolyston Street and Fenway*

Table 3-4 provides a summary of the 35 crashes that took place at this intersection between 2006 and 2010. Thirty-four percent were rear end; 29 percent were angle; and 20 percent were sideswipe collisions. The majority (66 percent) occurred during clear weather and nearly one-third (31percent) took place during the AM or PM peak period.

**Table 3-4**
**Crashes at Charlesgate at Boylston**

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2006–10 Total | 2006–10 Average |
|---|---|---|---|---|---|---|---|---|
| Total Number of Crashes | | 10 | 8 | 6 | 5 | 6 | 35 | 7 |
| Crash Severity | Property Damage Only | 7 | 4 | 4 | 4 | 4 | 23 | 4.6 |
| | Personal injury | 1 | 1 | 2 | 1 | 1 | 6 | 1.2 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 2 | 3 | 0 | 0 | 1 | 6 | 1.2 |
| Collision Type | Angle | 0 | 3 | 3 | 2 | 2 | 10 | 2 |
| | Rear-end | 5 | 2 | 1 | 1 | 3 | 12 | 2.4 |
| | Sideswipe | 1 | 3 | 2 | 0 | 1 | 7 | 1.4 |
| | Head-on | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Single Vehicle | 1 | 0 | 0 | 2 | 0 | 3 | 0.6 |
| | Not Reported | 2 | 0 | 0 | 0 | 0 | 2 | 0.4 |
| Roadway Conditions | Wet/Icy Pavement | 1 | 1 | 1 | 1 | 1 | 5 | 1 |
| | Dark/Lit | 5 | 2 | 1 | 1 | 2 | 11 | 2.2 |
| Weather Conditions | Clear | 8 | 4 | 5 | 2 | 4 | 23 | 4.6 |
| | Cloudy | 0 | 1 | 0 | 1 | 1 | 3 | 0.6 |
| | Rain | 2 | 1 | 1 | 1 | 1 | 6 | 1.2 |
| | Snow | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| Crashes During Weekday Peak Periods* | | 6 | 2 | 1 | 2 | 0 | 11 | 2.2 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 1 | 0 | 1 | 0.2 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 1 | 0 | 1 | 0.2 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Charlesgate East at Commonwealth Avenue – Eastbound*

Thirty-three crashes are shown in Table 3-5 for this location and 64 percent of them were angle type. A large proportion (52 percent) occurred in the dark, suggesting that better lighting may help to address safety issues.

**Table 3-5**
**Crashes at Charlesgate East at Commonwealth Avenue – Eastbound**

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2006–10 Total | 2006–10 Average |
|---|---|---|---|---|---|---|---|---|
| Total Number of Crashes | | 4 | 12 | 11 | 6 | 0 | 33 | 6.6 |
| Crash Severity | Property Damage Only | 3 | 8 | 7 | 5 | 0 | 23 | 4.6 |
| | Personal injury | 1 | 3 | 4 | 1 | 0 | 9 | 1.8 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| Collision Type | Angle | 2 | 6 | 7 | 6 | 0 | 21 | 4.2 |
| | Rear-end | 0 | 1 | 1 | 0 | 0 | 2 | 0.4 |
| | Sideswipe | 1 | 3 | 3 | 0 | 0 | 7 | 1.4 |
| | Head-on | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| | Single Vehicle | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| | Not Reported | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| Roadway Conditions | Wet/Icy Pavement | 0 | 2 | 1 | 1 | 0 | 4 | 0.8 |
| | Dark/Lit | 2 | 4 | 8 | 3 | 0 | 17 | 3.4 |
| Weather Conditions | Clear | 3 | 11 | 7 | 4 | 0 | 25 | 5 |
| | Cloudy | 1 | 0 | 2 | 0 | 0 | 3 | 0.6 |
| | Rain | 0 | 1 | 1 | 0 | 0 | 2 | 0.4 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 0 | 5 | 2 | 1 | 0 | 8 | 1.6 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 1 | 0 | 1 | 0.2 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Charlesgate East at Commonwealth Avenue – Westbound*

Of the 43 crashes at this intersection, shown in Table 3-6, the collision type was not reported 21percent of the time. The number of crashes in each of the past two years of the analysis is almost equivalent to that of the first three years combined.

**Table 3-6**
**Crashes at Charlesgate East at Commonwealth Avenue – Westbound**

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2006–10 Total | 2006–10 Average |
|---|---|---|---|---|---|---|---|---|
| Total Number of Crashes | | 9 | 2 | 4 | 15 | 13 | 43 | 8.6 |
| Crash Severity | Property Damage Only | 4 | 2 | 2 | 8 | 8 | 24 | 4.8 |
| | Personal injury | 4 | 0 | 0 | 6 | 3 | 13 | 2.6 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 1 | 0 | 2 | 1 | 2 | 6 | 1.2 |
| Collision Type | Angle | 2 | 2 | 0 | 11 | 9 | 24 | 4.8 |
| | Rear-end | 2 | 0 | 1 | 2 | 0 | 5 | 1 |
| | Sideswipe | 0 | 0 | 2 | 0 | 3 | 5 | 1 |
| | Head-on | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Single Vehicle | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 5 | 0 | 1 | 2 | 1 | 9 | 1.8 |
| Roadway | Wet/Icy Pavement | 0 | 0 | 1 | 1 | 1 | 3 | 0.6 |
| Conditions | Dark/Lit | 4 | 1 | 0 | 3 | 6 | 14 | 2.8 |
| Weather Conditions | Clear | 7 | 2 | 3 | 9 | 7 | 28 | 5.6 |
| | Cloudy | 1 | 0 | 0 | 2 | 2 | 5 | 1 |
| | Rain | 0 | 0 | 1 | 1 | 0 | 2 | 0.4 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 2 | 0 | 2 | 8 | 3 | 15 | 3 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Charlesgate West at Commonwealth Avenue – Eastbound*

There was only one crash reported between 2006 and 2010 at this intersection. The crash occurred on an evening in March 2010, and involved a personal injury; it was an angle crash and weather did not appear to be a contributing factor.

### *Charlesgate West at Commonwealth Avenue – Westbound*

There were 60 crashes at this intersection and 42percent of them involved an injury, as shown in Table 3-7. Three of the crashes involved pedestrians and one involved a bicyclist. The majority of the crash types were angle. Thirty-eight percent of the crashes took place during the AM or PM peak period. There were more crashes in 2008, 2009, and 2010 than there were in 2006 or 2007.

**Table 3-7**
**Crashes at Charlesgate West at Commonwealth Avenue – Westbound**

| | | | | | | | 2006–10 | |
|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| Total Number of Crashes | | 9 | 8 | 13 | 14 | 16 | 60 | 12 |
| Crash Severity | Property Damage Only | 6 | 4 | 8 | 6 | 9 | 33 | 6.6 |
| | Personal injury | 3 | 4 | 4 | 7 | 7 | 25 | 5 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 0 | 1 | 1 | 0 | 2 | 0.4 |
| Collision Type | Angle | 4 | 5 | 6 | 10 | 12 | 37 | 7.4 |
| | Rear-end | 1 | 1 | 2 | 1 | 1 | 6 | 1.2 |
| | Sideswipe | 0 | 1 | 3 | 1 | 2 | 7 | 1.4 |
| | Head-on | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Single Vehicle | 0 | 0 | 0 | 1 | 1 | 2 | 0.4 |
| | Not Reported | 4 | 1 | 2 | 1 | 0 | 8 | 1.6 |
| Roadway Conditions | Wet/Icy Pavement | 1 | 4 | 1 | 2 | 5 | 13 | 2.6 |
| | Dark/Lit | 1 | 2 | 5 | 7 | 3 | 18 | 3.6 |
| Weather Conditions | Clear | 8 | 3 | 10 | 6 | 6 | 33 | 6.6 |
| | Cloudy | 0 | 1 | 3 | 2 | 1 | 7 | 1.4 |
| | Rain | 1 | 3 | 0 | 2 | 3 | 9 | 1.8 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 4 | 4 | 5 | 6 | 4 | 23 | 4.6 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 3 | 0 | 3 | 0.6 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Charlesgate East at Beacon Street*

Table 3-8 indicates that there were 55 crashes at this intersection, and 42 percent of them involved injuries. Forty-seven percent occurred during the peak period, suggesting that they may be congestion related. More than half of the crashes were angle, followed by sideswipe collisions (16 percent).

**Table 3-8**
**Crashes at Charlesgate East at Beacon Street**

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2006–10 Total | 2006–10 Average |
|---|---|---|---|---|---|---|---|---|
| **Total Number of Crashes** | | **12** | **10** | **11** | **8** | **14** | **55** | **11** |
| Crash Severity | Property Damage Only | 7 | 3 | 7 | 3 | 7 | 27 | 5.4 |
| | Personal injury | 4 | 6 | 3 | 5 | 5 | 23 | 4.6 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 1 | 1 | 1 | 0 | 2 | 5 | 1 |
| Collision Type | Angle | 7 | 3 | 6 | 6 | 9 | 31 | 6.2 |
| | Rear-end | 3 | 1 | 0 | 0 | 1 | 5 | 1 |
| | Sideswipe | 0 | 2 | 4 | 1 | 2 | 9 | 1.8 |
| | Head-on | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| | Single Vehicle | 0 | 0 | 1 | 0 | 1 | 2 | 0.4 |
| | Not Reported | 2 | 3 | 0 | 1 | 0 | 6 | 1.2 |
| Roadway Conditions | Wet/Icy Pavement | 3 | 2 | 0 | 0 | 3 | 8 | 1.6 |
| | Dark/Lit | 1 | 4 | 4 | 1 | 5 | 15 | 3 |
| Weather Conditions | Clear | 8 | 6 | 9 | 3 | 5 | 31 | 6.2 |
| | Cloudy | 2 | 2 | 1 | 2 | 2 | 9 | 1.8 |
| | Rain | 1 | 1 | 0 | 0 | 2 | 4 | 0.8 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 6 | 3 | 5 | 6 | 6 | 26 | 5.2 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes Involving Bicyclist(s) | | 0 | 1 | 0 | 1 | 0 | 2 | 0.4 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Charlesgate West at Beacon Street*

As shown in Table 3-9, most of the 57 crashes involved property damage only and occurred during clear weather, daylight, and dry road conditions. Fifty-one percent of the crashes were angle, followed by 23 percent sideswipe collisions.

**Table 3-9**
**Crashes at Charlesgate West at Beacon Street**

| | | | | | | | 2006–10 | |
|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| Total Number of Crashes | | 11 | 16 | 10 | 9 | 11 | 57 | 11.4 |
| Crash Severity | Property Damage Only | 8 | 12 | 8 | 7 | 8 | 43 | 8.6 |
| | Personal injury | 3 | 2 | 2 | 1 | 2 | 10 | 2 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 2 | 0 | 1 | 1 | 4 | 0.8 |
| Collision Type | Angle | 3 | 9 | 5 | 6 | 6 | 29 | 5.8 |
| | Rear-end | 2 | 0 | 1 | 1 | 3 | 7 | 1.4 |
| | Sideswipe | 2 | 5 | 4 | 0 | 2 | 13 | 2.6 |
| | Head-on | 0 | 0 | 0 | 1 | 0 | 1 | 0.2 |
| | Single Vehicle | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 4 | 2 | 0 | 1 | 0 | 7 | 1.4 |
| Roadway | Wet/Icy Pavement | 1 | 0 | 2 | 2 | 3 | 8 | 1.6 |
| Conditions | Dark/Lit | 2 | 1 | 3 | 1 | 3 | 10 | 2 |
| Weather Conditions | Clear | 9 | 16 | 7 | 4 | 6 | 42 | 8.4 |
| | Cloudy | 1 | 0 | 2 | 0 | 1 | 4 | 0.8 |
| | Rain | 1 | 0 | 1 | 2 | 1 | 5 | 1 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 5 | 5 | 4 | 5 | 3 | 22 | 4.4 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Charlesgate East at Marlborough Street*

There were no crashes reported at this intersection between 2006 and 2010.

### *Saint James Avenue at Dartmouth Street*

This location had considerably fewer crashes (23) than many of the other study intersections. However, the predominate number of the incidents shown in Table 3-10 (48 percent) involved personal injuries. Forty-three percent of the crashes occurred in the dark during clear weather, suggesting that lighting might have been an issue; and 43 percent took place during the peak period.

**Table 3-10**
**Crashes at Saint James Avenue at Dartmouth Street**

| | | | | | | | 2006–10 | |
|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| Total Number of Crashes | | 6 | 4 | 8 | 3 | 2 | 23 | 4.6 |
| Crash | Property Damage Only | 2 | 2 | 3 | 0 | 2 | 9 | 1.8 |
| Severity | Personal injury | 3 | 2 | 4 | 2 | 0 | 11 | 2.2 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 1 | 0 | 1 | 1 | 0 | 3 | 0.6 |
| Collision Type | Angle | 3 | 1 | 4 | 1 | 0 | 9 | 1.8 |
| | Rear-end | 1 | 1 | 0 | 1 | 0 | 3 | 0.6 |
| | Sideswipe | 0 | 2 | 2 | 0 | 0 | 4 | 0.8 |
| | Head-on | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Single Vehicle | 0 | 0 | 0 | 1 | 1 | 2 | 0.4 |
| | Not Reported | 2 | 0 | 2 | 0 | 1 | 5 | 1 |
| Roadway | Wet/Icy Pavement | 0 | 1 | 1 | 0 | 0 | 2 | 0.4 |
| Conditions | Dark/Lit | 2 | 2 | 3 | 1 | 2 | 10 | 2 |
| Weather | Clear | 5 | 2 | 6 | 3 | 1 | 17 | 3.4 |
| Conditions | Cloudy | 1 | 0 | 2 | 0 | 0 | 3 | 0.6 |
| | Rain | 0 | 2 | 0 | 0 | 0 | 2 | 0.4 |
| | Snow | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| Crashes During Weekday Peak Periods* | | 3 | 2 | 3 | 1 | 1 | 10 | 2 |
| Crashes Involving Pedestrian(s) | | 0 | 1 | 0 | 1 | 0 | 2 | 0.4 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

## *Stuart Street at Arlington Street*

Table 3-11 shows that there were 29 incidents at this location, and the collision types were more varied than at most of the other study intersections: thirty-four percent were angle; 21 percent were sideswipe; 17percent were rear-end; 14percent were single vehicle crashes; and 14 percent were unreported. Forty-one percent of incidents occurred during non-daylight hours.

**Table 3-11**
**Crashes at Stuart Street at Arlington Street**

| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2006–10 Total | 2006–10 Average |
|---|---|---|---|---|---|---|---|---|
| **Total Number of Crashes** | | **6** | **4** | **8** | **3** | **2** | **23** | **4.6** |
| Crash Severity | Property Damage Only | 2 | 2 | 3 | 0 | 2 | 9 | 1.8 |
| | Personal injury | 3 | 2 | 4 | 2 | 0 | 11 | 2.2 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 1 | 0 | 1 | 1 | 0 | 3 | 0.6 |
| Collision Type | Angle | 3 | 1 | 4 | 1 | 0 | 9 | 1.8 |
| | Rear-end | 1 | 1 | 0 | 1 | 0 | 3 | 0.6 |
| | Sideswipe | 0 | 2 | 2 | 0 | 0 | 4 | 0.8 |
| | Head-on | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Single Vehicle | 0 | 0 | 0 | 1 | 1 | 2 | 0.4 |
| | Not Reported | 2 | 0 | 2 | 0 | 1 | 5 | 1 |
| Roadway | Wet/Icy Pavement | 0 | 1 | 1 | 0 | 0 | 2 | 0.4 |
| Conditions | Dark/Lit | 2 | 2 | 3 | 1 | 2 | 10 | 2 |
| Weather Conditions | Clear | 5 | 2 | 6 | 3 | 1 | 17 | 3.4 |
| | Cloudy | 1 | 0 | 2 | 0 | 0 | 3 | 0.6 |
| | Rain | 0 | 2 | 0 | 0 | 0 | 2 | 0.4 |
| | Snow | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| Crashes During Weekday Peak Periods* | | 3 | 2 | 3 | 1 | 1 | 10 | 2 |
| Crashes Involving Pedestrian(s) | | 0 | 1 | 0 | 1 | 0 | 2 | 0.4 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

### *Kenmore Square*

As shown in Table 3-12, only 13 incidents were reported at this location between 2006 and 2010; and none during 2009 or 2010. There were an equal number (3) of angle and sideswipe collisions.

**Table 3-12**
**Crashes at Kenmore Square**

| | | | | | | | 2006–10 | |
|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| **Total Number of Crashes** | | 5 | 5 | 3 | 0 | 0 | 13 | 2.6 |
| Crash Severity | Property Damage Only | 5 | 4 | 3 | 0 | 0 | 12 | 2.4 |
| | Personal injury | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| Collision Type | Angle | 2 | 1 | 0 | 0 | 0 | 3 | 0.6 |
| | Rear-end | 0 | 2 | 0 | 0 | 0 | 2 | 0.4 |
| | Sideswipe | 2 | 0 | 1 | 0 | 0 | 3 | 0.6 |
| | Head-on | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Single Vehicle | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| | Not Reported | 1 | 1 | 2 | 0 | 0 | 4 | 0.8 |
| Roadway Conditions | Wet/Icy Pavement | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Dark/Lit | 1 | 2 | 1 | 0 | 0 | 4 | 0.8 |
| Weather Conditions | Clear | 5 | 5 | 2 | 0 | 0 | 12 | 2.4 |
| | Cloudy | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| | Rain | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

## *Bowker Overpass at Boylston Street*

As shown in Table 3-13, 25 incidents were reported at this location, and 48 percent of them were rear-end collisions. Twenty percent were in non-daylight hours and 72 percent were during clear weather.

**Table 3-13**
**Crashes at Bowker Overpass at Boylston Street**

| | | | | | | | 2006–10 | |
|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| **Total Number of Crashes** | | **8** | **3** | **10** | **1** | **3** | **25** | **5** |
| Crash | Property Damage Only | 5 | 2 | 7 | 0 | 0 | 14 | 2.8 |
| Severity | Personal injury | 3 | 0 | 2 | 0 | 1 | 6 | 1.2 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 1 | 1 | 1 | 2 | 5 | 1 |
| Collision Type | Angle | 2 | 0 | 3 | 0 | 0 | 5 | 1 |
| | Rear-end | 5 | 1 | 3 | 1 | 2 | 12 | 2.4 |
| | Sideswipe | 1 | 1 | 2 | 0 | 1 | 5 | 1 |
| | Head-on | 0 | 0 | 2 | 0 | 0 | 2 | 0.4 |
| | Single Vehicle | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| Roadway | Wet/Icy Pavement | 1 | 0 | 2 | 0 | 1 | 4 | 0.8 |
| Conditions | Dark/Lit | 2 | 0 | 1 | 0 | 2 | 5 | 1 |
| Weather | Clear | 7 | 1 | 8 | 1 | 1 | 18 | 3.6 |
| Conditions | Cloudy | 0 | 1 | 1 | 0 | 1 | 3 | 0.6 |
| | Rain | 0 | 0 | 1 | 0 | 1 | 2 | 0.4 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 2 | 0 | 0 | 0 | 0 | 2 | 0.4 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

## *Beacon Street at Massachusetts Avenue*

Table 3-14 indicates that there were 40 crashes at this intersection and 40 percent of them involved injuries. Four involved pedestrians, and another four involved bicyclists.

Thirty-five percent were rear-end collisions; 20 percent were sideswipe; and 18 percent were angle crashes. Fifty percent of the crashes occurred during daylight hours.

**Table 3-14**
**Crashes at Beacon Street at Massachusetts Avenue**

| | | | | | | | 2006–10 | |
|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| Total Number of Crashes | | 12 | 10 | 3 | 7 | 8 | 40 | 8 |
| Crash Severity | Property Damage Only | 5 | 5 | 3 | 2 | 1 | 16 | 3.2 |
| | Personal injury | 5 | 3 | 0 | 4 | 4 | 16 | 3.2 |
| | Fatality | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Reported | 2 | 2 | 0 | 1 | 3 | 8 | 1.6 |
| Collision Type | Angle | 2 | 1 | 1 | 2 | 1 | 7 | 1.4 |
| | Rear-end | 5 | 3 | 2 | 2 | 2 | 14 | 2.8 |
| | Sideswipe | 3 | 3 | 0 | 1 | 1 | 8 | 1.6 |
| | Head-on | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| | Single Vehicle | 0 | 1 | 0 | 1 | 3 | 5 | 1 |
| | Not Reported | 2 | 2 | 0 | 1 | 0 | 5 | 1 |
| Roadway Conditions | Wet/Icy Pavement | 1 | 3 | 1 | 2 | 2 | 9 | 1.8 |
| | Dark/Lit | 4 | 5 | 2 | 4 | 5 | 20 | 4 |
| Weather Conditions | Clear | 9 | 8 | 1 | 5 | 5 | 28 | 5.6 |
| | Cloudy | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| | Rain | 1 | 2 | 2 | 1 | 2 | 8 | 1.6 |
| | Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crashes During Weekday Peak Periods* | | 6 | 2 | 1 | 2 | 0 | 11 | 2.2 |
| Crashes Involving Pedestrian(s) | | 0 | 0 | 0 | 2 | 2 | 4 | 0.8 |
| Crashes Involving Bicyclist(s) | | 0 | 0 | 0 | 1 | 3 | 4 | 0.8 |

*Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

## 3.4 BOWKER OVERPASS: ORIGINS/DESTINATIONS VEHICLE TRIP PATHS

During the course of the study, staff determined it would be vital to include where the vehicles that are using the Bowker Overpass are coming from and where are they going. The Boston Region MPO's regional transportation model was used to develop vehicle origins and destinations, and determine the primary roadways that were being used to access the Bowker Overpass.

### 3.4.1 Bowker Overpass: Origin and Destinations

The following figures provide information related to the origin and destination of vehicles using the Bowker Overpass based on data for the AM peak period. Table 3-15 summarizes the origins and destinations of vehicles using the Bowker Overpass in both directions. As the table shows, 56.2 percent of all northbound vehicles using the Bowker Overpass originate in seven Boston neighborhoods, with nearly a quarter of the vehicles coming from the Fenway/Kenmore neighborhoods. In the southbound direction, 91 percent of all vehicles are destined for these same neighborhoods, with 51.3 percent going to Fenway and Kenmore.

**Table 3-15**
**Summary of Vehicles Using the Bowker Overpass:**
**Origins and Destinations in AM Peak Period**

| Boston Neighborhood | Origins (Bowker NB) | Destinations (Bowker SB) |
|---|---|---|
| Back Bay | 2.0% | 15.8% |
| Fenway/Kenmore | 22.9% | 51.3% |
| Jamaica Plain | 12.7% | 7.3% |
| North Dorchester | 2.3% | 1.1% |
| Roxbury | 7.6% | 4.9% |
| South End | 2.7% | 5.8% |
| Brookline | 6.1% | 4.9% |
| TOTAL | 56.2% | 91.0% |

#### *Northbound Bowker Overpass Origin and Destinations*

Figures 3-16 and 3-17 show where vehicle trips using the Bowker Overpass originate from. This data is reflected by traffic analysis zone (TAZ), a unit of geography used for travel demand modelling and designed to capture households with similar socioeconomic characteristics. The majority of the vehicle trips originated from the Fenway/Kenmore District, which includes the Longwood Medical Area and Jamaica Plain.

The primary destinations for northbound Bowker Overpass vehicle trips are Cambridge and other Boston districts, as shown in Figures 3-18 and 3-19. Figure 3-19 displays a detailed map indicating that the primary Boston destinations are Beacon Hill, the West End, Charlestown, and East Boston.

### *Southbound Bowker Overpass Origin and Destinations*

Vehicle trips using the southbound Bowker Overpass originate from a number of places, as shown in Figure 3-20. Figure 3-21 shows that many trips originate in Beacon Hill, the West End, Charlestown, and East Boston.

The primary destinations for southbound Bowker Overpass vehicle trips are shown in Figures 3-22 and 3-23. The primary destination is immediately south of the Bowker Overpass, in the Fenway and Kenmore neighborhoods, and the LMA area.

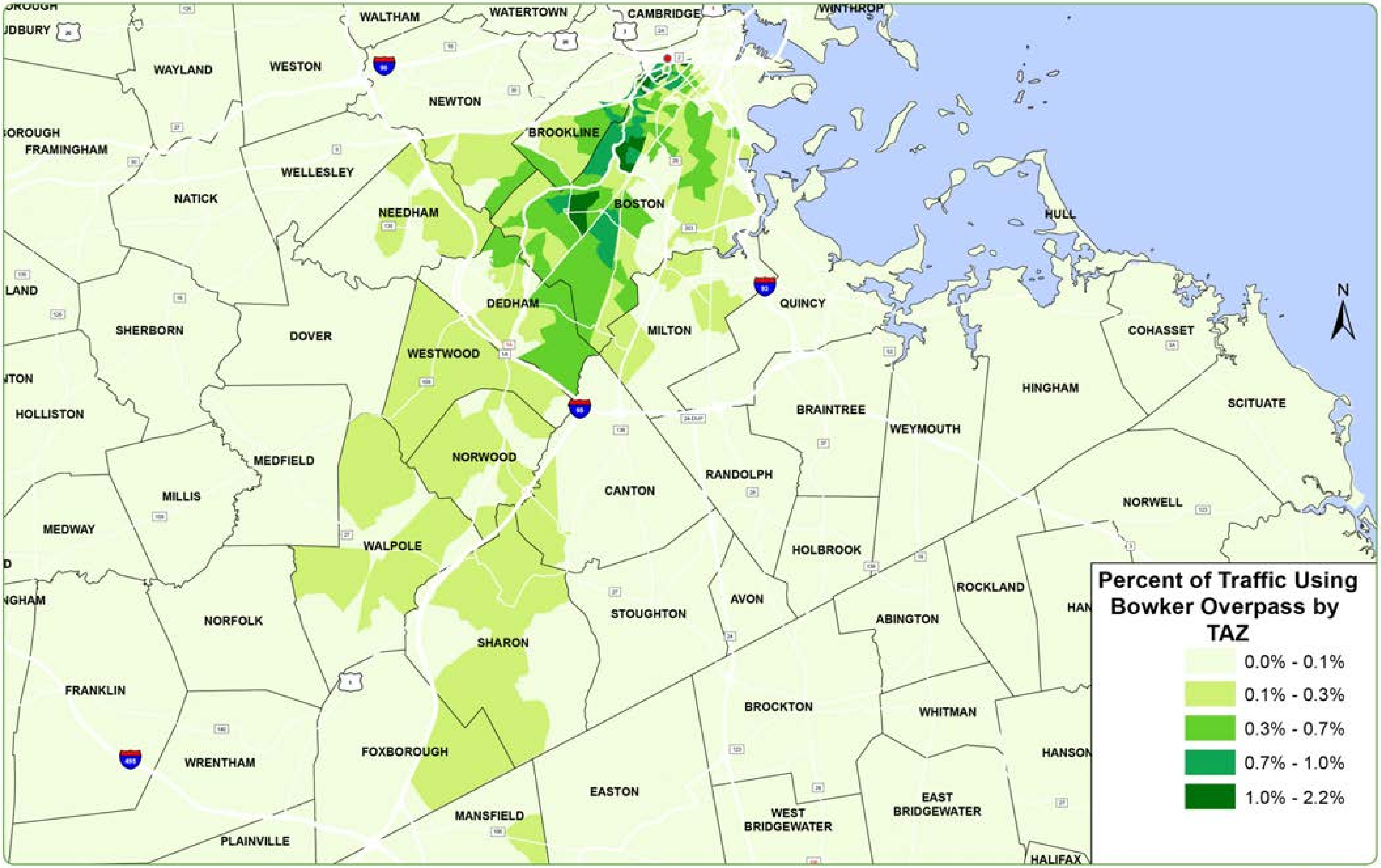



**FIGURE 3-16**
**Northbound Bowker Origins - Regional View**

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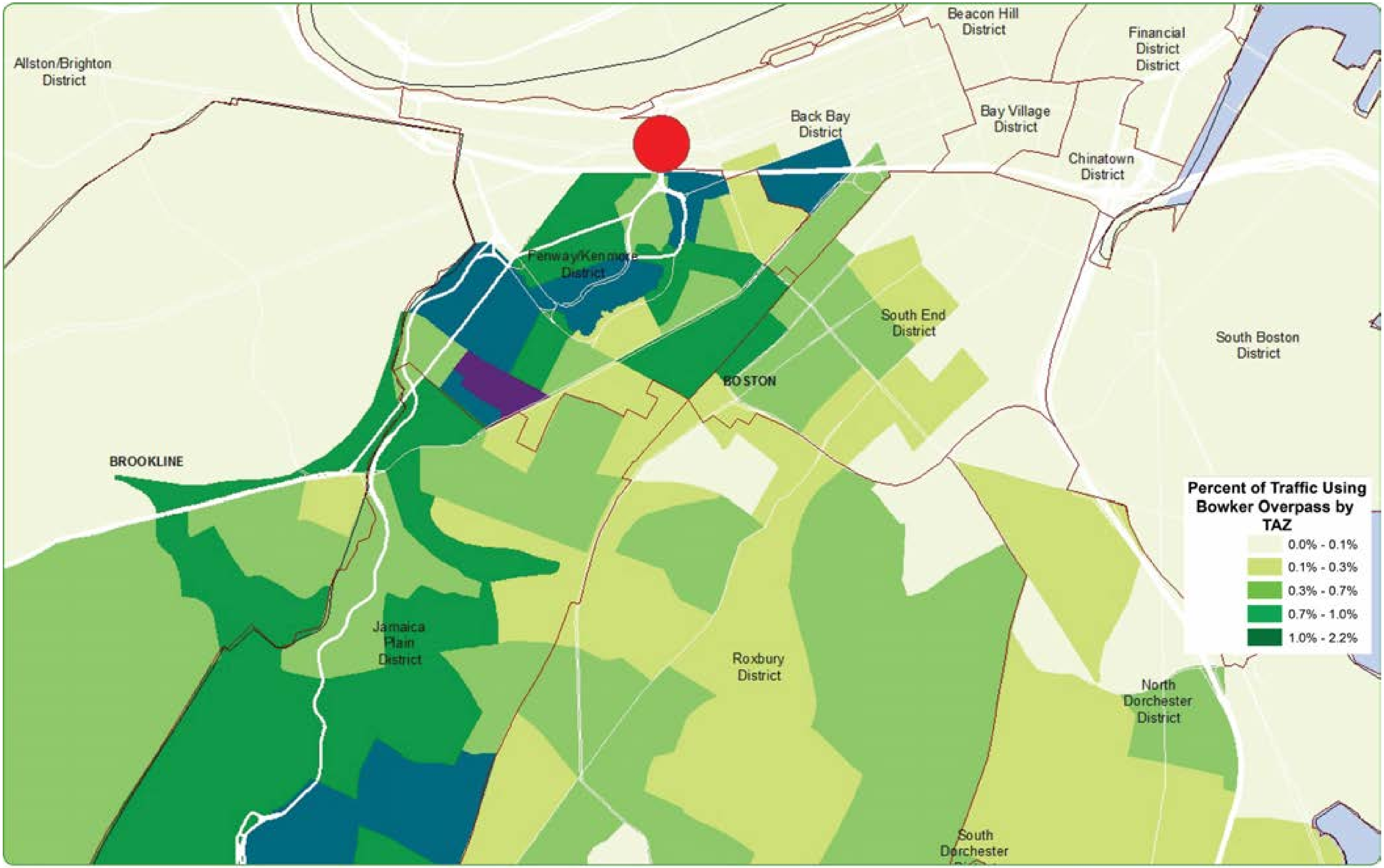


**FIGURE 3-17**
**Northbound Bowker Origins - Neighborhood View**

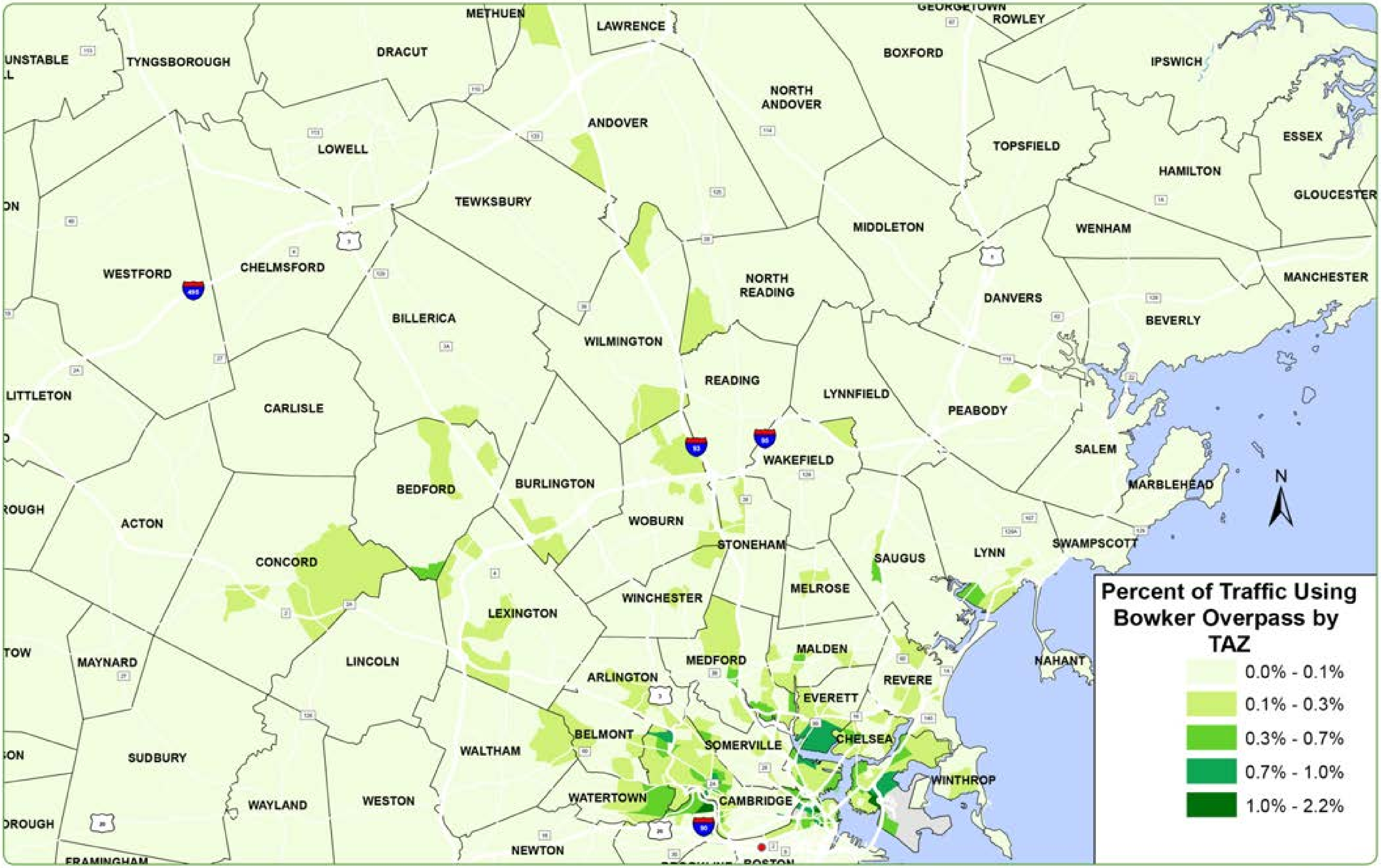


**FIGURE 3-18**
**Northbound Bowker Destinations - Regional View**

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**FIGURE 3-19**
**Northbound Bowker Destinations - Neighborhood View**


**FIGURE 3-20**
**Southbound Bowker Origins - Regional View**

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**FIGURE 3-21**
**Southbound Bowker Origins - Neighborhood View**

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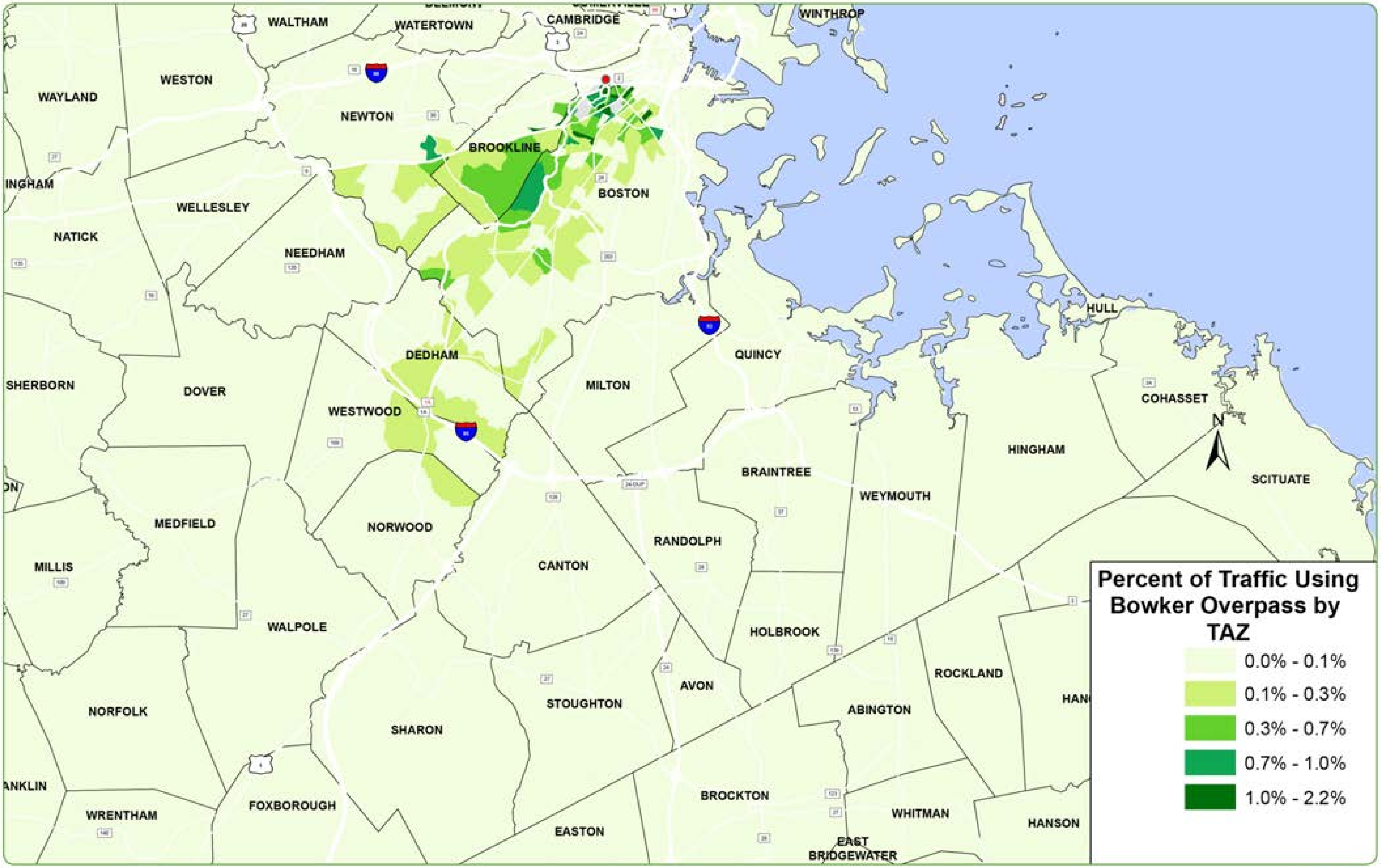


**FIGURE 3-22**
**Southbound Bowker Destinations - Regional View**

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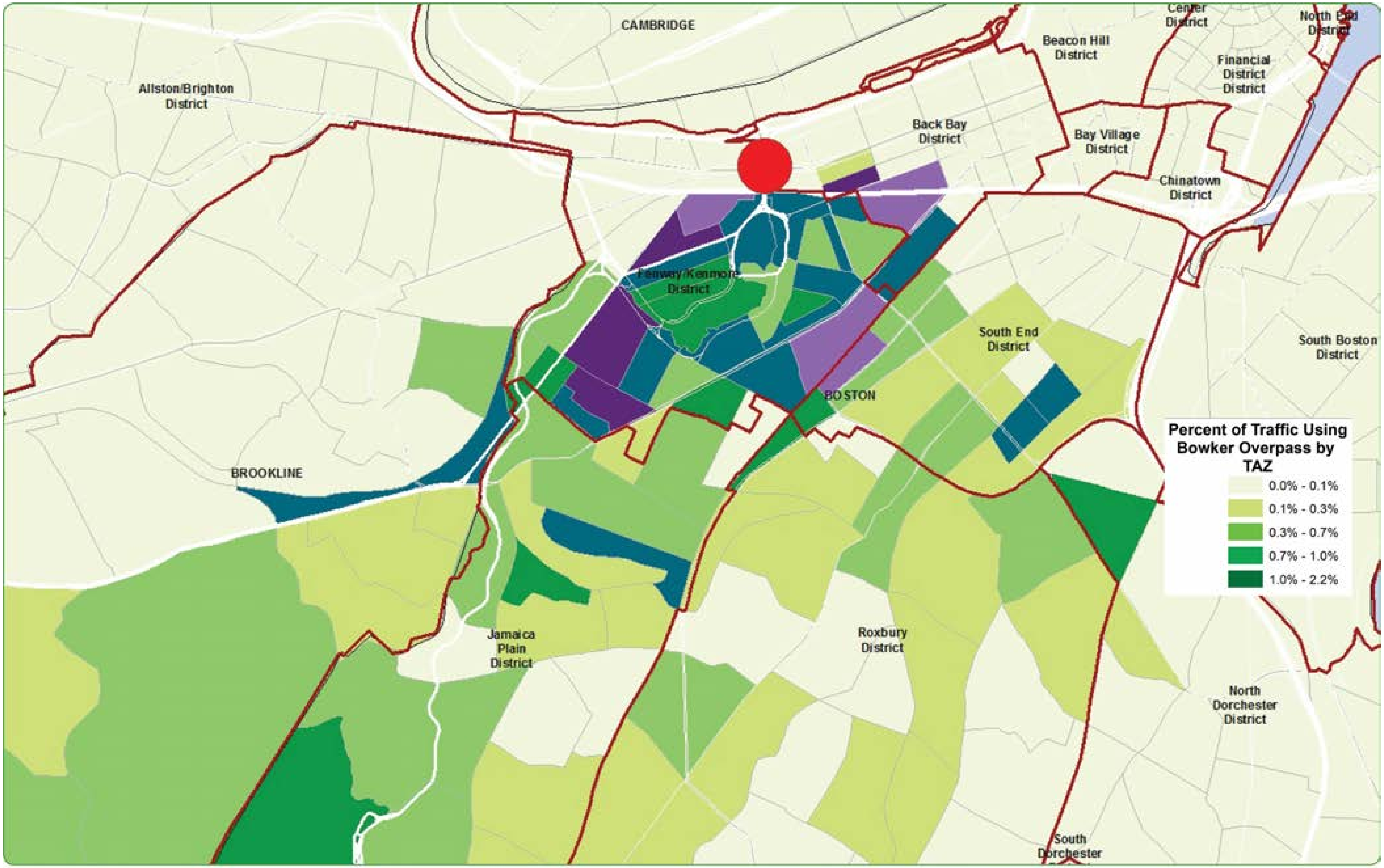


**FIGURE 3-23**
**Southbound Bowker Destinations - Neighborhood View**

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### 3.4.2 Bowker Overpass: Vehicle Trip Paths

The following figures provide information related to the various paths Bowker Overpass vehicle trips use. Figure 3-24 shows the paths that northbound Bowker Overpass vehicle trips use. As shown, many trips use the Jamaicaway and Brookline Avenue south of the Bowker Overpass, represented by the heavy blue lines. North of the overpass, Storrow Drive in both directions is the primary roadway used by northbound trips.

**Figure 3-24**
**Northbound Bowker Roadways**

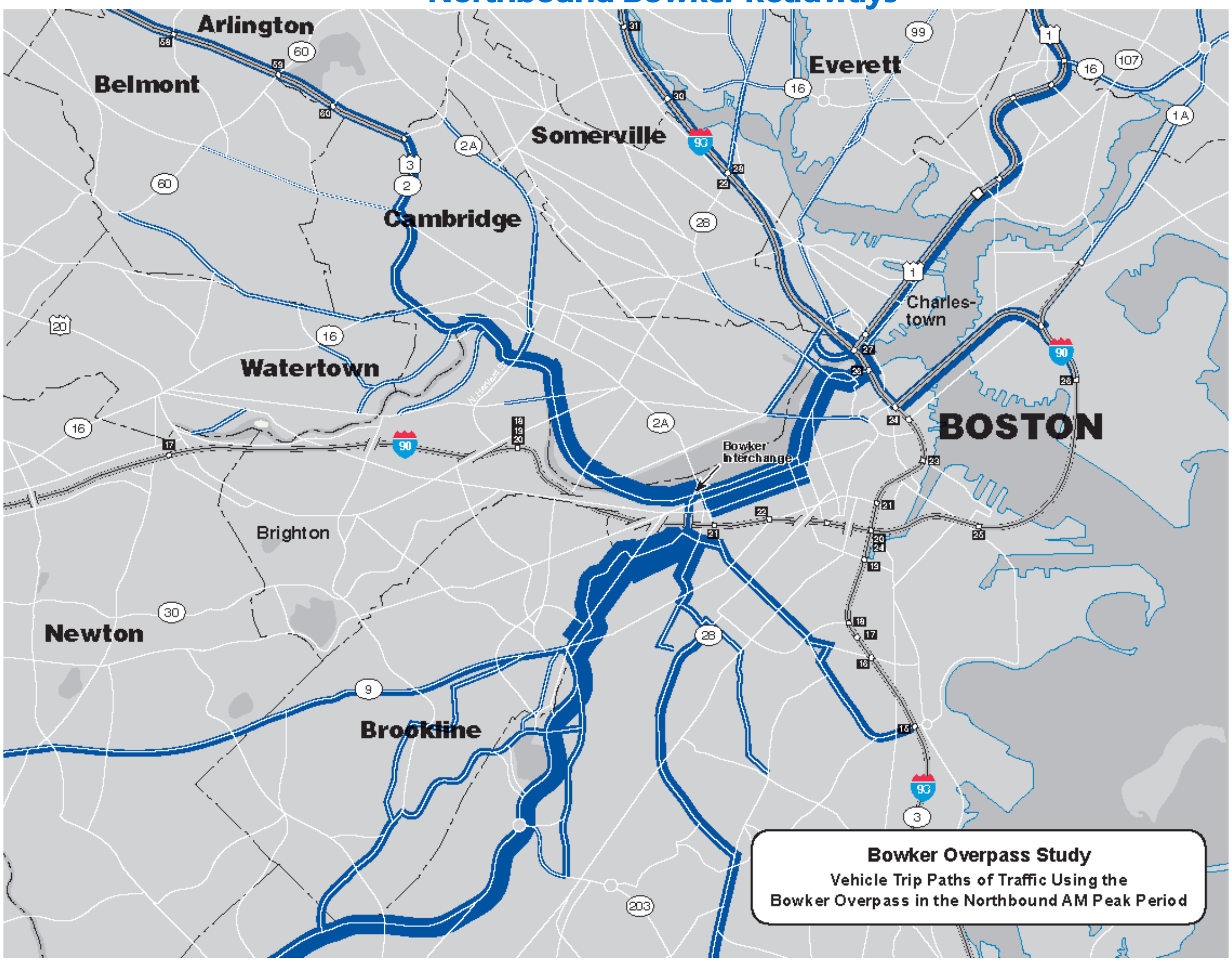
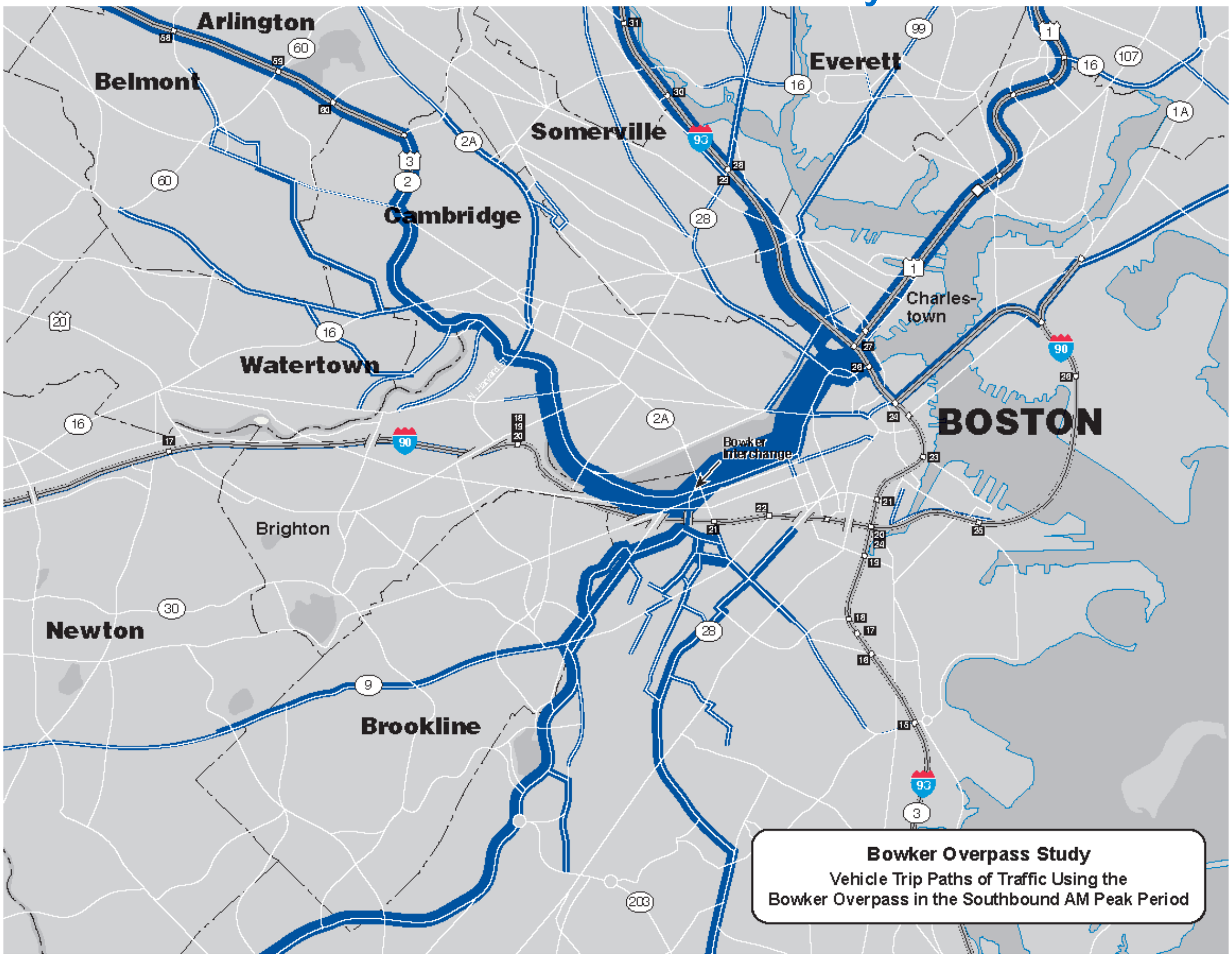



Figure 3-25 shows the roadways used by the southbound Bowker Overpass vehicle trips. As shown in the figure, north of the Bowker Overpass the primary roadways are I-93, Route 1, and Storrow Drive from both directions. South of the overpass the primary roadways are Brookline Avenue, Jamaicaway, and Route 9 west.

## Figure 3-25
## Southbound Bowker Roadways



# Chapter 4—Project Alternatives: Massachusetts Turnpike Ramps

## 4.1 INTRODUCTION

This chapter describes four new ramp alternatives on the Massachusetts Turnpike Extension in Boston's Back Bay that were developed to meet three of the study's goals:

- Reduce traffic within the study area on the arterials and local streets.
- Improve highway connections between Back Bay and crucial locations to the east, including but not limited to the Seaport District and Logan Airport.
- Improve regional highway connections to the Longwood Medical Area (LMA) without having an impact on local roads.

## 4.2 DEVELOPMENT OF RAMP ALTERNATIVES

In response to the need for improved roadway connections between the Back Bay and areas to the east, legislation was authorized in 1995 that directed the Massachusetts Turnpike Authority (now folded into the Massachusetts Department of Transportation [MassDOT]), the Boston Transportation Department (BTD), and the Boston Redevelopment Authority (BRA) to conduct a joint study to provide an eastbound on-ramp and/or a westbound off-ramp on the Massachusetts Turnpike Extension between Chinatown and the Fenway area.

The result of this legislation was the Boston Extension Ramps Feasibility Study, which was released in 1997. The purpose of this study was to determine the feasibility of adding an additional ramp or ramps to the Massachusetts Turnpike Extension in order to provide improved access between the Back Bay and Logan Airport and the emerging commercial area in the Seaport District.

The eight alternatives that were developed as part of this study are detailed below; four of them were chosen to be defined in further detail in this chapter:

### 4.2.1 Alternative 1 – Arlington Street Eastbound On-Ramp

The Arlington Street on-ramp alignment would begin at the Arlington Street/Tremont Street intersection, parallel Herald Street, and merge with the Boston Extension of the Massachusetts Turnpike just west of the South Bay interchange.

### 4.2.2 Alternative 2 – Westbound Off-Ramp at Harrison Avenue/Marginal Road

A proposed Central Artery/Tunnel Project ramp would provide egress from the Massachusetts Turnpike westbound to the Harrison Avenue/Marginal Road intersection in Chinatown.

### 4.2.3 Alternative 3 – Berkeley Street Westbound Off-Ramp

The Berkeley Street off-ramp alignment would begin in the vicinity of the South Bay interchange and terminate at Berkeley Street just south of Cortes Street. This alignment would require closure of the existing Arlington Street westbound on-ramp.

### 4.2.4 Alternative 4 – Stuart Street Westbound Off-Ramp

The Stuart Street off-ramp alignment would begin in the vicinity of the South Bay interchange and terminate at Stuart Street in the vicinity of the John Hancock Air Rights Garage at Trinity Place (a small intersecting street). This alignment would require the closure of two existing Boston Extension ramps: the Arlington Street westbound on-ramp and the Clarendon Street westbound on-ramp.

### 4.2.5 Alternative 5 – Boylston Street Eastbound On-Ramp

The Boylston Street on-ramp alignment would begin at the Bowker Overpass and would merge with the Boston Extension just west of the existing Massachusetts Avenue overpass.

### 4.2.6 Alternative 6 – Brookline Avenue Eastbound On-Ramp

The Brookline Avenue on-ramp alignment would begin at the existing Brookline Avenue overpass in the Kenmore Square area, run parallel to Lansdowne Street, and merge with the Boston Extension.

### 4.2.7 Alternative 7 – Newbury Street Westbound Off-Ramp

The Newbury Street off-ramp would begin in the vicinity of the Massachusetts Avenue overpass, run parallel to Newbury Street, and terminate at Commonwealth Avenue at the Bowker Overpass. This alignment would require closure of the existing Massachusetts Avenue westbound on-ramp.

### 4.2.8 Alternative 8 – Brookline Avenue Westbound Off-Ramp

The Brookline Avenue off-ramp alignment would begin in the vicinity of the Bowker Overpass, run parallel to (and possibly within the right of way of) Newbury Street, and terminate at Brookline Avenue just south of Kenmore Square. This alignment would possibly require closure of the existing Massachusetts Avenue westbound on-ramp.

## 4.3 MASSACHUSETTS TURNPIKE RAMP ALTERNATIVES

In June 2012, MassDOT conducted a public meeting to present four of the ramp alternatives that had been developed. These alternatives were based on the previous study's eight alternatives (listed above); however, they had been further refined based on feasibility and public input to meet the study's goals. The four final ramp alternatives are:

- Back Bay Alternative 1: New Westbound Off-Ramp to Berkeley Street
- Back Bay Alternative 2: New Westbound Off-Ramp to Trinity Place/Stuart Street
- Back Bay Alternative 3: New Westbound Off-Ramp to Brookline Avenue
- Back Bay Alternative 4: New Eastbound On-Ramp from the Bowker Overpass

### 4.3.1 Back Bay Alternative 1: New Westbound Off-Ramp to Berkeley Street

Back Bay Alternative 1 includes construction of a new Massachusetts Turnpike westbound off-ramp that connects to Berkeley Street. Figure 4-1 provides a conceptual design of the proposed alternative. This alternative would provide direct access from I-93, I-90, Logan Airport, and the Seaport District to the Back Bay, which does not presently exist. Currently, indirect access is provided by a U-turn at the Allston/Brighton interchange, which allows westbound Massachusetts Turnpike vehicles (with an E-Z Pass) to make a U-turn and then head eastbound and exit at the Prudential Tunnel off-ramp.

Figure 4-2 – Reconstruction of Arlington Street and Tremont Street Bridge Structures

The Back Bay Alternative 1 off-ramp deceleration lane would begin just east of the Shawmut Street Bridge and travel parallel to Marginal Road. As the off-ramp approaches Tremont Street, the ramp would diverge from the Massachusetts Turnpike and encroach upon Marginal Road. The off-ramp would pass under the reconstructed bridges at Tremont Street and Arlington Street (Figure 4-2). It would then begin to rise in order

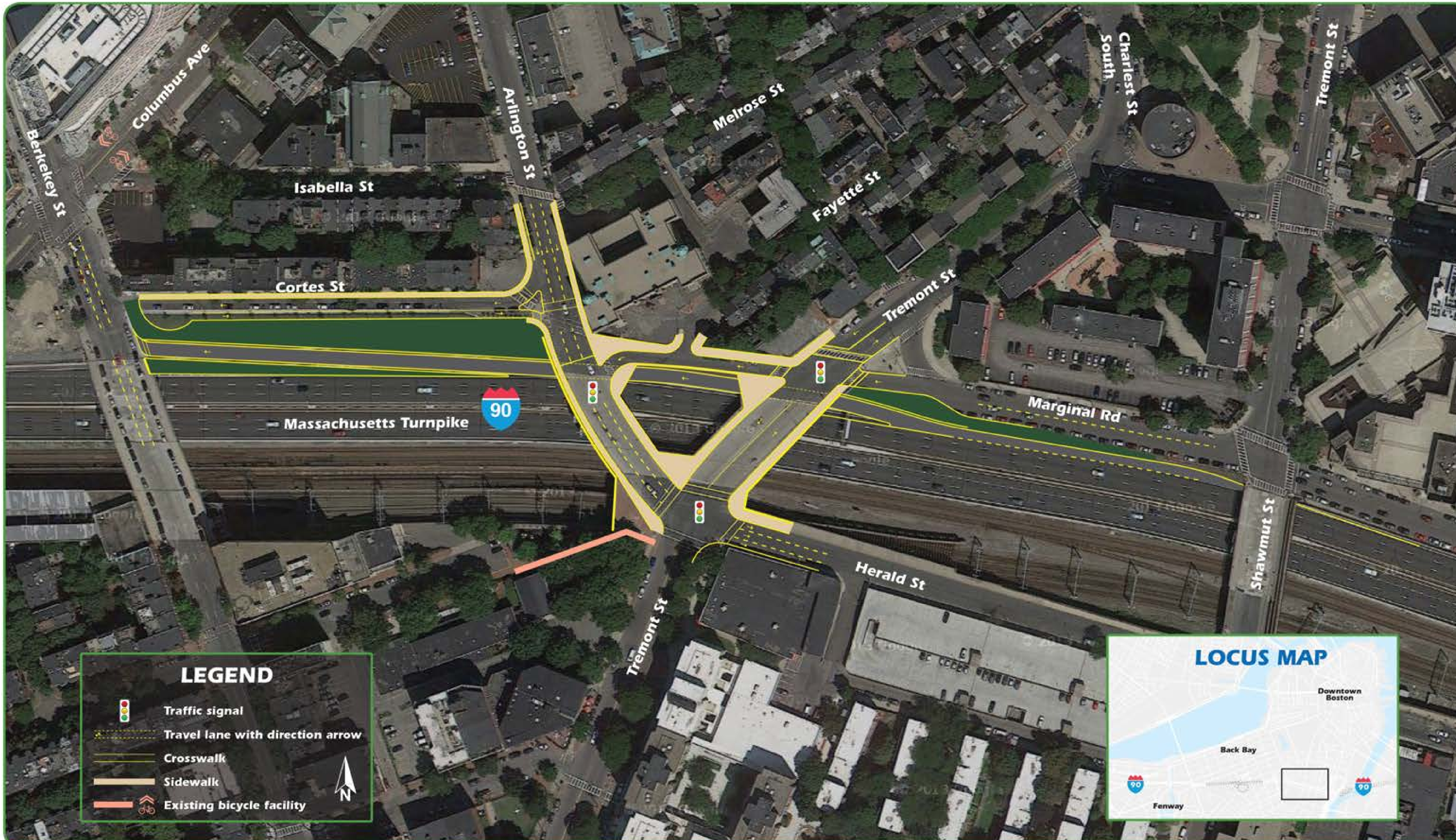



**FIGURE 4-1**
**Back Bay Alternative 1**
**New Westbound Off-Ramp to Berkeley Street**

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to connect with a new at-grade intersection at Berkeley Street (Figure 4-3). Because of this new Berkeley Street intersection with the off-ramp, Cortes Street would need to be closed to through traffic and made into a two-way street to allow continued access to its residences.

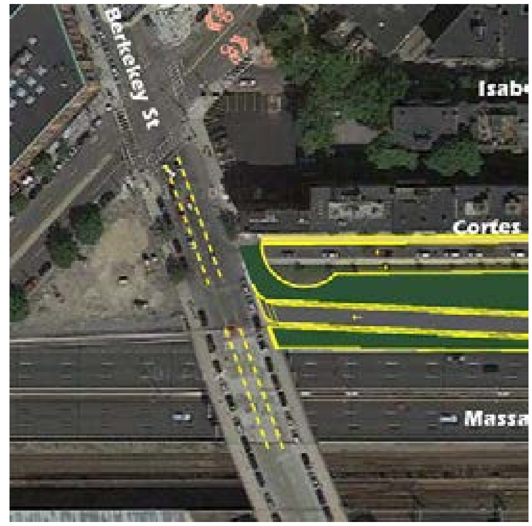

Figure 4-3 – New Berkeley Street Off-Ramp Intersection

The Back Bay Alternative 1 off-ramp would require the closure of the existing Massachusetts Turnpike westbound on-ramp at Arlington Street. This would eliminate a Back Bay access point to the Turnpike and require existing on-ramp traffic to divert to the Clarendon Street on-ramp located beneath the Hancock Garage or the on-ramp at Dartmouth Street.

Reconstruction of the Tremont and Arlington Street bridges would create an opportunity to improve east-west bicycle and pedestrian travel along Herald Street, Marginal Road, Arlington Street, and Cortes Street, providing that a pedestrian connection to Berkeley Street from Cortes Street is retained. With the exception of Cortes Street, each of these streets is included in Boston's 30-year Bike Network plan, with a cycle track planned for Herald and Arlington Streets. Pedestrian and bicyclist conflict with vehicles exiting the Massachusetts Turnpike at Berkeley Street would need to be addressed in any proposed intersection design.

There are a number of issues and impacts associated with the proposed Back Bay Alternative 1 off-ramp. The list below provides a summary of the benefits, issues, and impacts of this alternative (this information is discussed in further detail in Chapter 9: Screening Evaluation):

- Provides westbound direct access to the Back Bay area from the Massachusetts Turnpike and the Seaport District.
- Closure of the existing Massachusetts Turnpike eastbound on-ramp at Arlington Street, causing traffic diversions to other streets and ramps.
- The high cost and neighborhood impacts associated with the reconstruction of the Arlington Street and Tremont Street bridge structures over the Massachusetts Turnpike in order to accommodate the proposed deceleration lane and off-ramp.
- Reconstruction of the three existing signalized intersections located on Arlington and Tremont streets.

- Marginal Road would be reduced from two lanes with on-street parking to a single lane as it approaches Tremont Street.
- On-street parking on Marginal Road (on the Massachusetts Turnpike side) would be removed to accommodate the proposed off-ramp.
- Closing of Cortes Street to through traffic, which would limit access to households along the street as well as neighborhood connectivity.

### 4.3.2 Back Bay Alternative 2: New Westbound Off-Ramp to Trinity Place/Stuart Street

Back Bay Alternative 2 includes construction of a new Massachusetts Turnpike westbound off-ramp that travels under the Hancock Garage and connects with Stuart Street. Figure 4-4 provides a conceptual design of the proposed alternative. This alternative would provide direct access from I-93, I-90, Logan Airport, and the Seaport District to the Back Bay, which does not presently exist. As with the other Back Bay Alternatives, indirect access currently is provided by a U-turn at the Allston/Brighton interchange and then an eastbound Prudential Tunnel exit to Stuart Street and Huntington Avenue.

The Back Bay Alternative 2 westbound off-ramp would diverge from the Massachusetts Turnpike westbound, just as it passes under the Arlington Street Bridge. The off-ramp would continue under the reconstructed bridges at Berkeley Street and Columbus Avenue. As it passes under Columbus Avenue, the off-ramp would then enter a tunnel section, traveling through Frieda Garcia Park and under Clarendon Street (Figure 4-5).

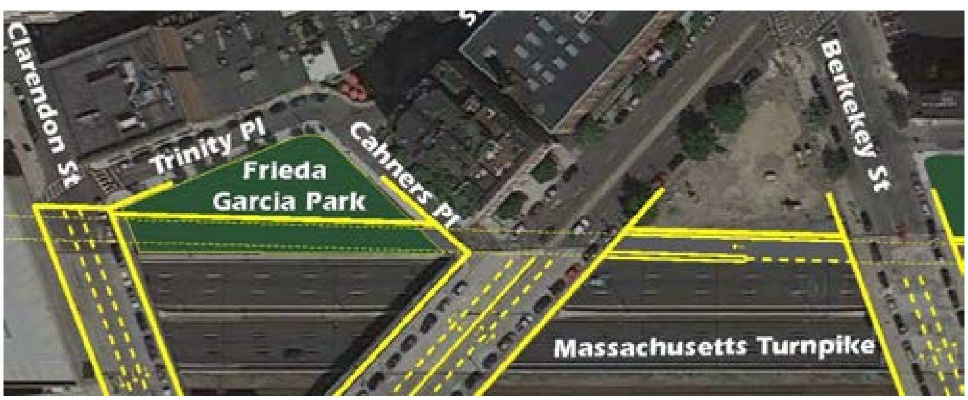


Figure 4-5 – Frieda Garcia Park

The off-ramp would then need to travel under and/or through a portion of the Hancock Garage before exiting the garage onto Trinity Place. Trinity Place would then intersect Stuart Street at the signalized intersection adjacent to the John Hancock Building (Figure 4-6).

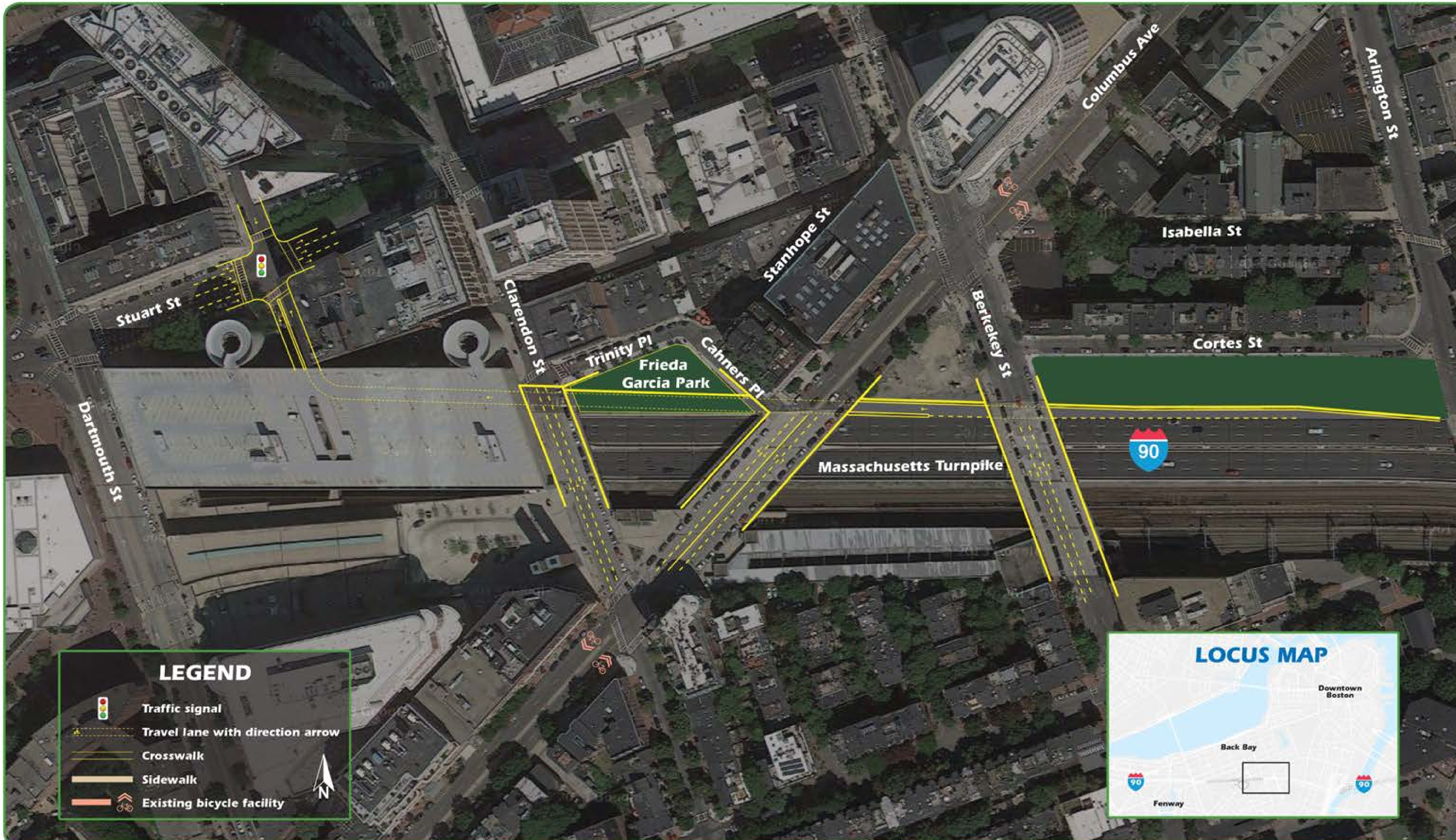


**FIGURE 4-4**
**Back Bay Alternative 2**
**New Westbound Off-Ramp to Trinity Place/Stuart Street**

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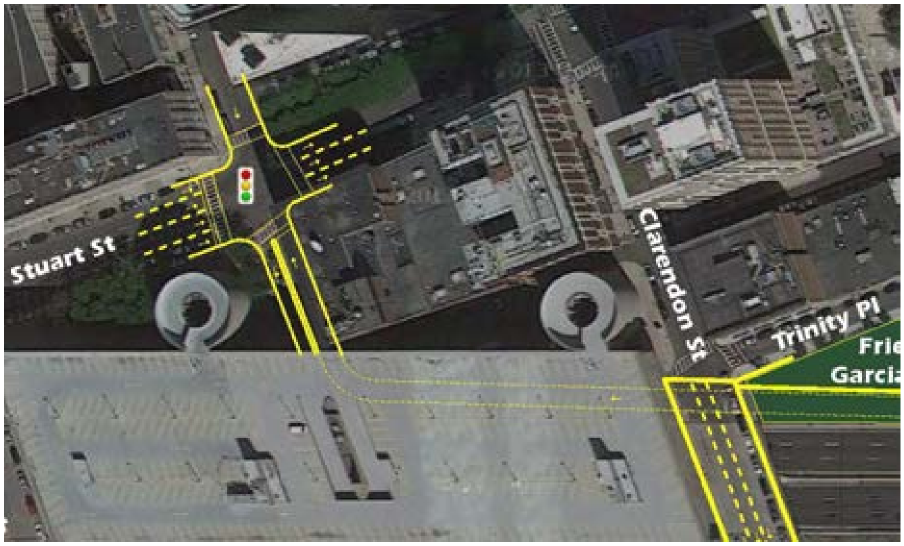
**Figure 4-6**
**Tunnel Under the Hancock Garage and the Stuart Street Intersection**




The Back Bay Alternative 2 westbound off-ramp would require the closure of two existing Massachusetts Turnpike westbound on-ramps. This alternative would require the closing of the Arlington Street on-ramp, as in Back Bay Alternative 1, and it would replace the existing Clarendon Street on-ramp. This would eliminate a Back Bay access point to the Turnpike, requiring that existing traffic use either the Massachusetts Avenue on-ramp or the Allston/Brighton interchange to access the westbound Massachusetts Turnpike.

Closure of the Arlington and Clarendon Street on-ramps would reduce the potential for bicycle and pedestrian conflict with vehicles at these intersections. Reconstruction of the Berkeley Street and Columbus Avenue bridges creates an opportunity to improve bicycle and pedestrian travel along these corridors. The proximity of Back Bay Station to this alternative requires the importance of safe pedestrian accommodations, which are being made available in planning for this alternative. A shared bicycle lane currently exists on Clarendon Street, which the City of Boston hopes to upgrade to a dedicated bicycle lane by the year 2018.

There are a number of issues and impacts associated with the proposed Back Bay Alternative 2 off-ramp. The list below provides a summary of the benefits, issues, and impacts of this alternative (this information is discussed in further detail in Chapter 9: Screening Evaluation):

- Provides westbound direct access to the Back Bay area from the Massachusetts Turnpike and the Seaport District.

- Closure of the existing Massachusetts Turnpike eastbound on-ramps at Arlington Street and Clarendon Street, which would divert all closed ramp traffic to the Dartmouth Street on-ramp.
- The high cost and neighborhood impacts associated with the reconstruction of the Berkeley Street, Columbus Avenue, and Clarendon Street bridge structures over the Massachusetts Turnpike in order to accommodate the proposed deceleration lane and off-ramp.
- Impacts to Frieda Garcia Park.
- Major reconstruction of the Hancock Garage to accommodate the off-ramp tunnel to Trinity Place.

### 4.3.3 Back Bay Alternative 3: New Westbound Off-Ramp to Brookline Avenue

Back Bay Alternative 3 includes construction of a new Massachusetts Turnpike westbound off-ramp that connects to Brookline Avenue near Kenmore Square and Fenway Park. Figure 4-7 provides a conceptual design of the proposed alternative. This alternative would provide direct access from I-93, I-90, Logan Airport, and the Seaport District to the Back Bay and Fenway area, which does not presently exist. As with the other Back Bay Alternatives, indirect access currently is provided by a U-turn at the Allston/Brighton interchange.

The Back Bay Alternative 3 westbound off-ramp would diverge from the Massachusetts Turnpike westbound, just as it passes under the Bowker Overpass. The off-ramp would continue parallel to the Massachusetts Turnpike and Newbury Street. This parallel section of the off-ramp would significantly impact Newbury Street, reducing the roadway from a single lane with on-street parking on both sides to a single lane with no parking (Figure 4-8).

Figure 4-8 – Newbury Street

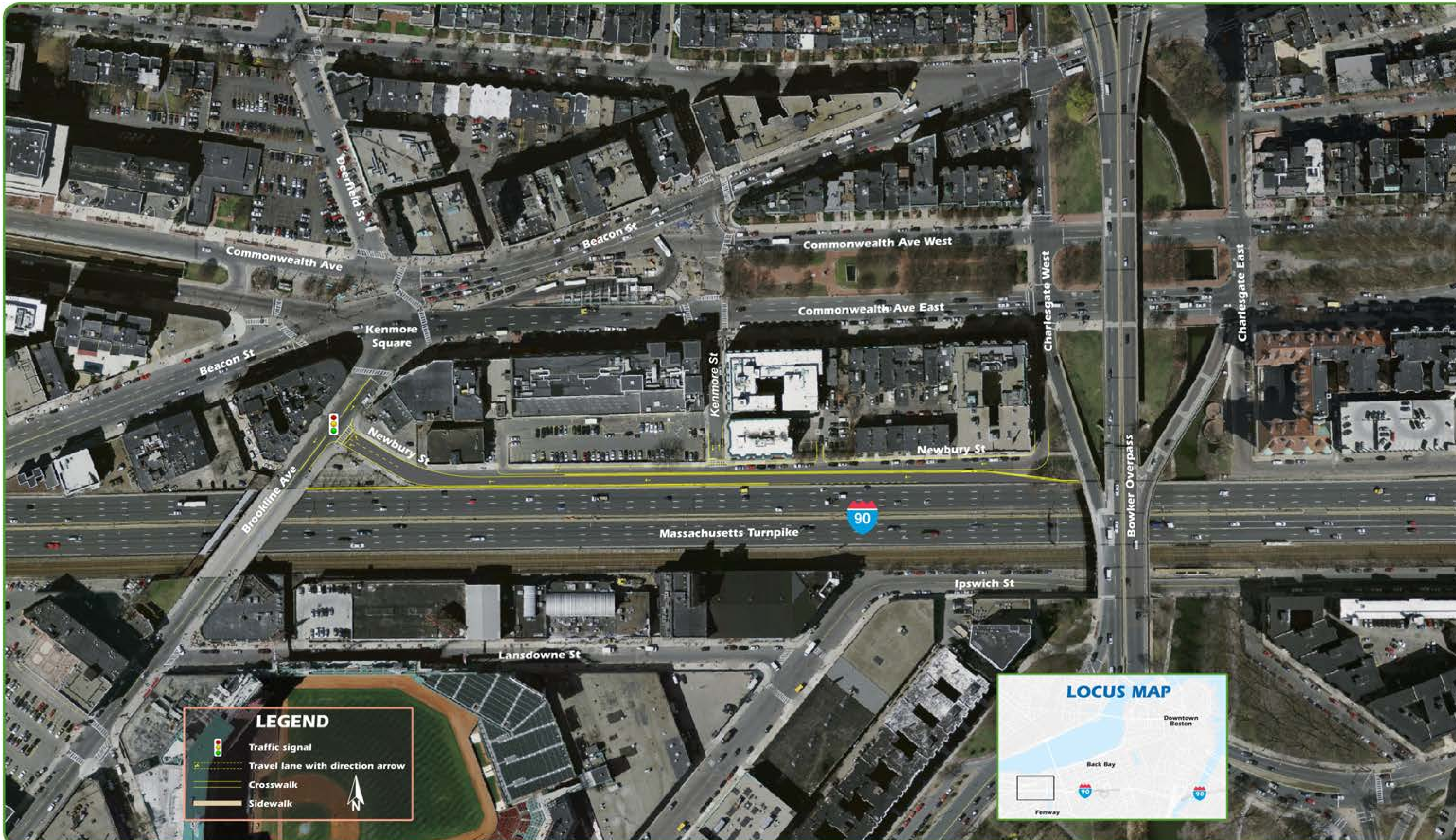



**FIGURE 4-7**
**Back Bay Alternative 3**
**New Westbound Off-Ramp to Brookline Avenue**

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As the ramp approaches Brookline Avenue, the alignment of the off-ramp would shift northward into Newbury Street (Figure 4-9). This shift would require that Newbury Street terminate at the western parking lot entrance of the Hotel Commonwealth, as shown in Figure 4-9.

Figure 4-9 – Newbury Street at Hotel Commonwealth's Parking Lot

The off-ramp would then widen to a two-lane approach at Brookline Avenue (Figure 4-10). A new signalized intersection would be installed, which would be approximately 150 feet south of Kenmore Square.

**Figure 4-10**
**New Signalized Intersection at Brookline Avenue**


This alternative could negatively impact bicycle and pedestrian conditions in the area. The presence of the Kenmore Massachusetts Bay Transportation Authority (MBTA) station and the retail and commercial activity in Kenmore Square to the north of the proposed off-ramp intersection, as well as Fenway Park and the retail and desirable destinations along Brookline Avenue and Lansdowne Street to the south, create

significant pedestrian travel along Brookline Avenue. Therefore, ensuring pedestrian and bicycle safety at the site of a new signalized intersection is important.

There are a number of issues and impacts associated with the proposed Alternative 3 off-ramp. The list below provides a summary of the benefits, issues, and impacts of this alternative (this information is discussed in further detail in Chapter 9: Screening Evaluation):

- Provides direct access to the Longwood Medical Area (LMA) and Fenway areas from the Massachusetts Turnpike westbound and the Seaport District.
- Potentially could require the closure of the existing Massachusetts Turnpike eastbound on-ramp at Massachusetts Avenue because of short weaving distance.
- Newbury Street would require reconstruction and reduction of available on-street parking.
- Newbury Street would no longer be a through connection to Brookline Avenue.
- Currently, the Hotel Commonwealth is expanding into the parking area shown in Figure 4-9. The proposed ramp would impact access to the hotel and its operations because deliveries are received on Newbury Street.
- A new off-ramp would impact access to the properties at 657 and 667 Boylston Street (buildings located north of Newbury Street, which are adjacent to the proposed ramp).
- A new Brookline Avenue signalized intersection located approximately 150 feet south of the Kenmore Square intersection would impact Kenmore Square traffic operations.
- Impact on bicycle and pedestrian safety along Brookline Avenue.

### 4.3.4 Back Bay Alternative 4: New Eastbound On-Ramp from the Bowker Overpass

Back Bay Alternative 4 includes construction of a new Massachusetts Turnpike eastbound on-ramp from the Bowker Overpass. Figure 4-11 provides a conceptual design of the proposed alternative. This alternative would provide direct access from the Fenway area and indirect access from parts of Back Bay to I-90 eastbound, I-93, Logan Airport, and the Seaport District. Currently, there are no eastbound Massachusetts Turnpike on-ramps east of the Allston/Brighton interchange.

Back Bay Alternative 4 would not provide a solution to the lack of a connection from I-93, I-90, Logan Airport, and the Seaport District to the Back Bay and Fenway area. Indirect access would still need to be provided by the U-turn at the Allston/Brighton interchange.

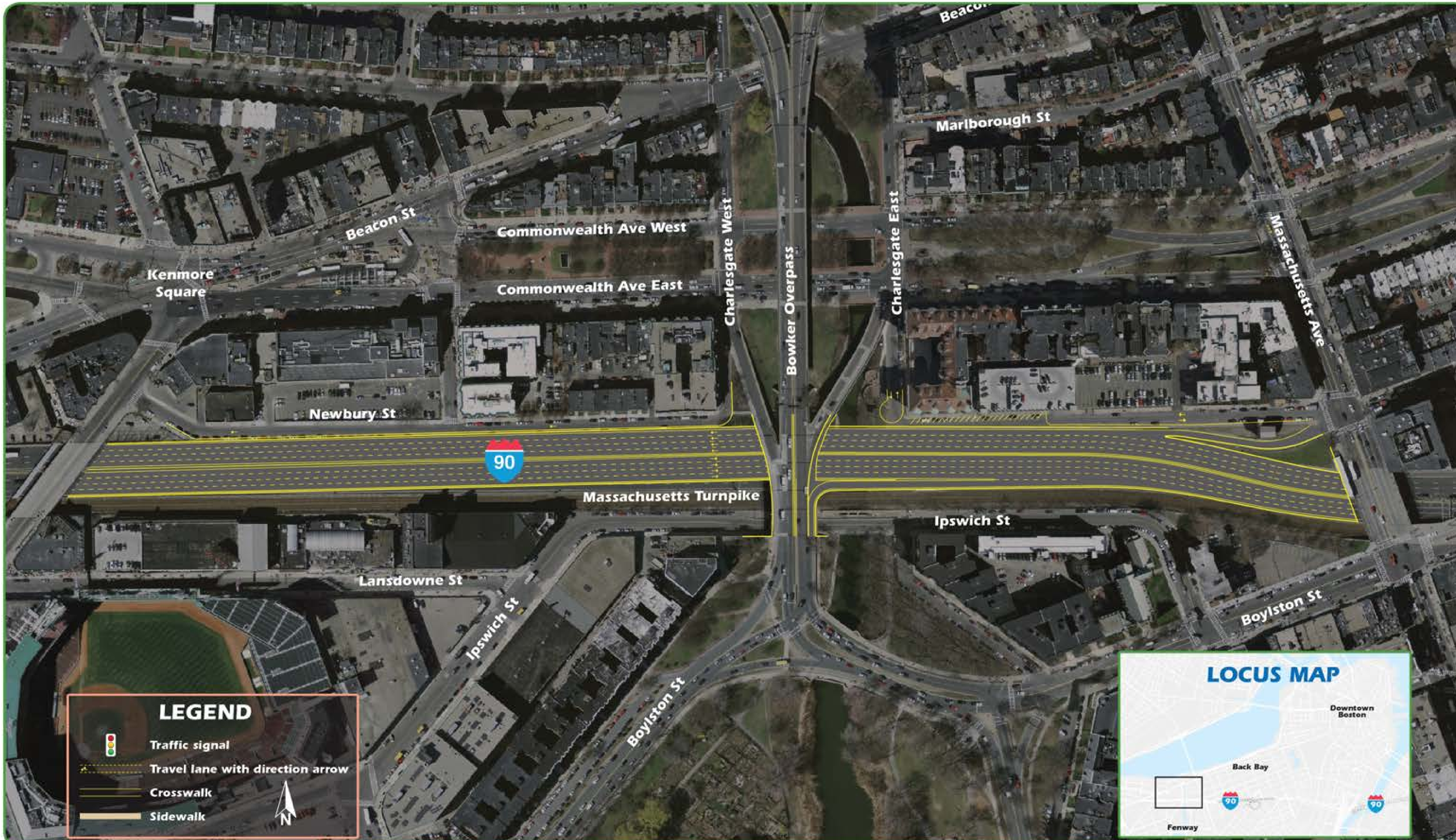



**FIGURE 4-11**
**Back Bay Alternative 4**
**New Eastbound On-Ramp from the Bowker Overpass**

Back Bay Alternative 4 would require major reconstruction of the Massachusetts Turnpike. The Turnpike alignment would need to be shifted northward in order to accommodate the new on-ramp (Figure 4-12). The shift would occur in the region of Brookline Avenue to Massachusetts Avenue. Widening to the south would impact the railroad tracks located adjacent to the Massachusetts Turnpike eastbound lanes. This shift of the Massachusetts Turnpike to the north would impact Newbury Street and its adjacent properties east and west of the Bowker Overpass.

The Bowker Overpass would be reconstructed and widened (Figure 4-12) to accommodate the proposed eastbound on-ramp and to provide improved bicycle and pedestrian accommodations over the Massachusetts Turnpike. The potential for bicycle or pedestrian conflict with vehicles turning right from the Bowker Overpass onto the Massachusetts Turnpike would be intensified in this alignment. A signalized crossing to allow safe pedestrian travel across the on-ramp would alleviate safety concerns but could significantly impact traffic flow during peak travel periods.

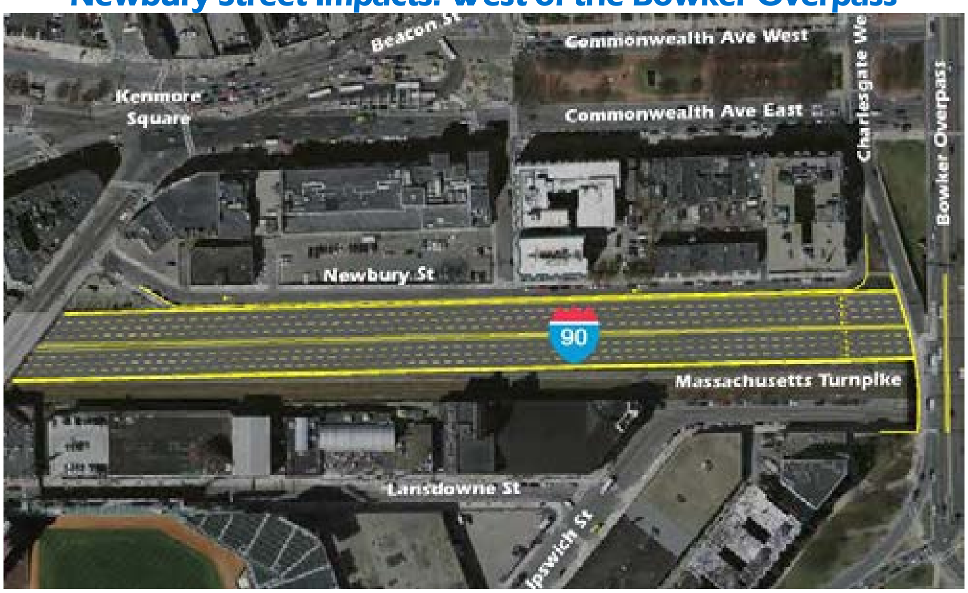
**Figure 4-12**
**Realignment of the Massachusetts Turnpike to the North**


As previously stated, the shift in alignment of the Massachusetts Turnpike would severely impact properties along Newbury Street, both east (Figure 4-13) and west (Figure 4-14) of the Bowker Overpass. Access to the properties would be severely impacted, and the closer alignment of the Massachusetts Turnpike to the buildings

themselves would also have an impact because of a probable increase in noise and vibration.

**Figure 4-13**
**Newbury Street Impacts: East of the Bowker Overpass**


**Figure 4-14**
**Newbury Street Impacts: West of the Bowker Overpass**




There are a number of issues and impacts associated with the proposed Back Bay Alternative 4 on-ramp. The list below provides a summary of the benefits, issues, and impacts of this alternative (this information is discussed in further detail in Chapter 9: Screening Evaluation):

- Provides a new Massachusetts Turnpike eastbound on-ramp for the LMA and Fenway area.
- Major reconstruction and shift of the Massachusetts Turnpike to the north.
- Severe impacts to Newbury Street and the adjacent properties.
- Newbury Street, east of the Bowker Overpass, would no longer connect to Charlesgate East.
- Currently, the Hotel Commonwealth is expanding into the parking area shown in Figure 4-14; the proposed ramp would impact access to the hotel and the adjacent property.

## 4.4 AREA-WIDE IMPROVEMENTS FOR BICYCLES AND PEDESTRIANS

This portion of the Massachusetts Turnpike acts as a natural border between the Back Bay, South End, and Chinatown neighborhoods. Regardless of which alternative is implemented, the entire region needs to be reviewed for improvements as MassDOT continues to improve the mode-shift goals and strives to improve bicycle and pedestrian accommodations. However, it should be noted that the biggest problem this area has to overcome is that land use has changed drastically over time.

To help create a space that is more bicycle and pedestrian friendly, this area in particular, needs to focus on the current lack of signage (primarily lane markings). The roads are wide enough, but striping in bicycle lanes or sharrows would allow a separation between the motorists and the cyclists, thereby providing a safer and more welcoming bicycling environment. Safety would be improved if motorists were made aware of exactly where they should be driving while allowing proper space for other modes of transportation. The entire area needs proper lane markings on the roads and pedestrian crosswalks. In addition to pedestrian crosswalks there should be plenty of median crossing islands, warning signs, and pedestrian signals.

In addition to specific signage for bicycle and pedestrian accommodations, in order to make a region bicycle and pedestrian friendly, there needs to be separation between the cars and the other modes of transit. Besides bicycle lanes, landscaping with trees and shrubs could help create distinct bicycle and pedestrian zones. Curb separation between the sidewalk and the road would also be helpful.

# Chapter 5—Project Alternatives – Bowker Overpass

## 5.1 INTRODUCTION

This chapter describes four new alternatives developed by MassDOT for the Bowker Overpass and its associated roadways to meet the study's goals identified below:

- Reduce traffic within the study area on the arterials and local streets.
- Improve highway connections between Back Bay and crucial locations to the east, including but not limited to the Seaport District and Logan Airport.
- Improve regional highway connections to the Longwood Medical Area without having an impact on local roads.
- Determine locations to reconstruct parkways and related roadway elements to lower capacity standards.

## 5.2 BOWKER OVERPASS ALTERNATIVES

The Bowker Overpass was constructed in 1965 and was under the Department of Conservation and Recreation's (DCR) ownership until 2009. As part of the Massachusetts transportation agencies' reconfiguration, ownership and maintenance of the Bowker Overpass was transferred to MassDOT in 2009. Since the transfer of ownership, the Bowker Overpass has required significant, annual maintenance repairs because of the deteriorating conditions of the overpass. In 2009, a new ramp was built, and in the fall of 2014, a significant project began to provide repairs to sustain the overpass for the next 10 years.

In June of 2012, MassDOT held a public meeting to provide an overview of the Bowker Overpass study and to begin planning a long-term strategy, which will help identify the significance of the Bowker Overpass. Several factors considered for the long-term strategy were:

- The Bowker Overpass is a major connection across the Massachusetts Turnpike, carrying approximately 52,500 vehicles per day.
- The overpass is a major pedestrian connection across the Massachusetts Turnpike.
- The overpass disrupts the connection between the Emerald Necklace and the Charles River Esplanade.
- The overpass serves as a barrier or border between the Kenmore and Back Bay neighborhoods.

At the June 2012 meeting, four preliminary Bowker Overpass alternatives were presented. The alternatives were developed in response to organizations that showed interest in altering or removing the Bowker Overpass. These preliminary alternatives have been further refined to meet this study's goals. The final Bowker Overpass alternatives are:

- Bowker Overpass Alternative 1: Bowker Overpass Removed
- Bowker Overpass Alternative 2: Bowker Overpass At-Grade
- Bowker Overpass Alternative 3: New Regional Access
- Bowker Overpass Alternative 4: New Regional and Local Access

These alternatives will not impact the proposed Charlesgate Greenway Connection, which would provide a shared-use path from Beacon Street to the Charles River path via Massachusetts Avenue. The shared-use path is included as part of all four alternatives.

### 5.2.1 Bowker Overpass Alternative 1: Bowker Overpass Removed

Bowker Overpass Alternative 1 eliminates the overpass, which connects the Massachusetts Turnpike to Storrow Drive. Figure 5-1 provides a conceptual design of the proposed alternative. The alternative's basic concept is to replace the flyover connection with reconstructed Charlesgate East and West roadways, bringing the traffic down to the at-grade roadways.

Bowker Overpass Alternative 1 requires a new bridge over the Massachusetts Turnpike and the ramps that access Commonwealth Avenue East (as shown in Figure 5-2). This new, five-lane structure would include sufficient width, improving pedestrian and bicycle accommodations.

Charlesgate East would be widened to accommodate increased traffic because of the removal of the overpass (as shown in Figure 5-3). Charlesgate East would become four lanes in the area between Commonwealth Avenue East and West. Charlesgate East would be widened to three lanes, with the addition of a bicycle lane between Commonwealth Avenue West and Beacon Street. Charlesgate West would remain with its current three-lane configuration, but it would be widened to accommodate a bicycle lane (as shown in Figure 5-4). The flyover ramps to Storrow Drive would be removed and the at-grade connections would be improved to accommodate the additional traffic. While there are benefits to the proposed Bowker Overpass Alternative 1, there are a number of issues and impacts associated with it. The list below provides a summary of the benefits and issues/impacts of the alternative:

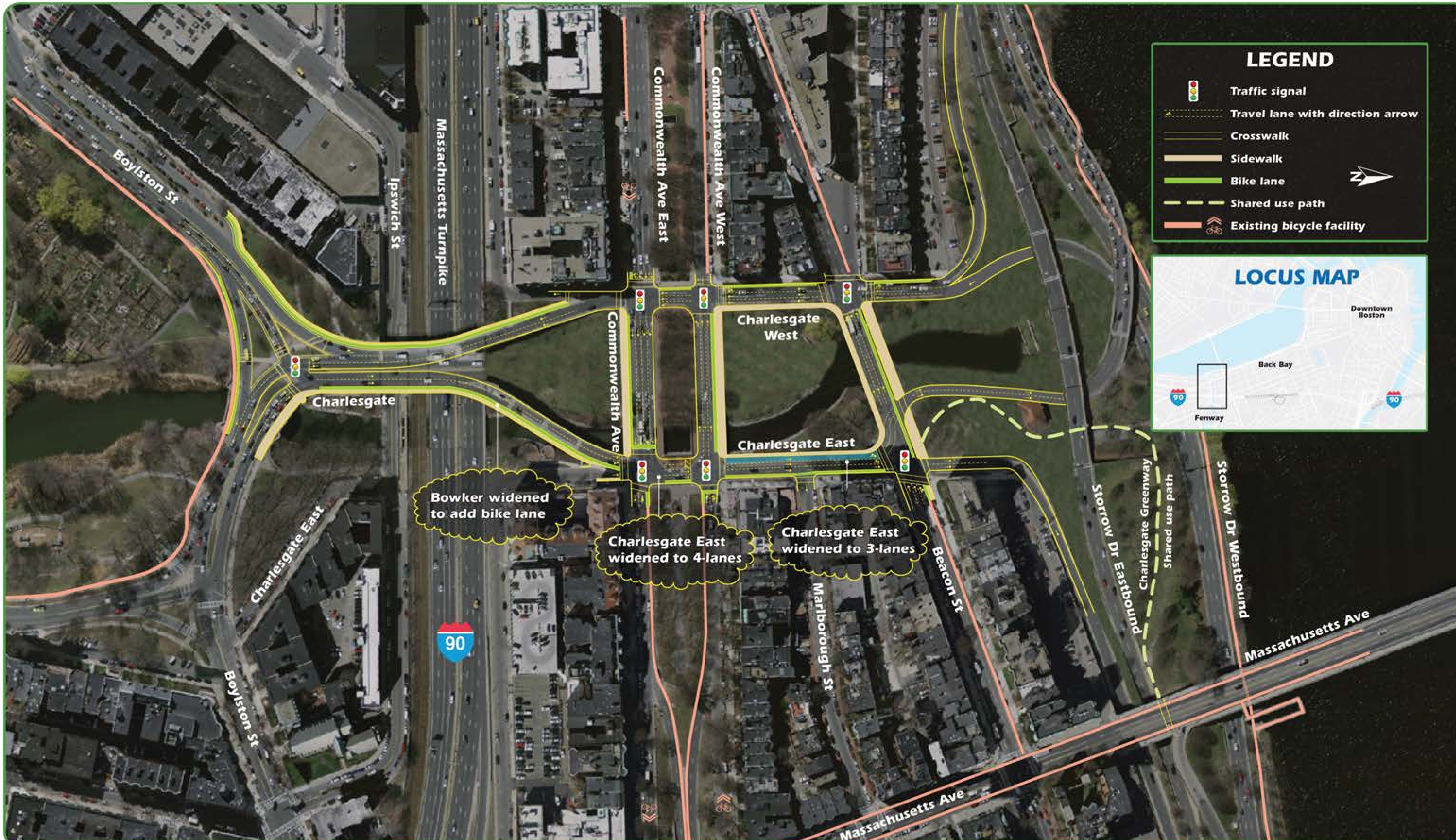



**FIGURE 5-1**
**Bowker Alternative 1**
**Bowker Overpass Removed**

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- The reconstructed bridge over the Massachusetts Turnpike and the reconstructed Charlesgate East and West ramps provides an opportunity to improve north-south pedestrian and bicycle accommodations.
- By removing the Bowker Overpass, the park's open space is increased.
- Other than the Charlesgate Greenway Connection, Alternative 1 does not improve access to the Charles River and pathways.
- The removal of the overpass would significantly increase traffic volumes on Charlesgate East and West roadways.
- The increase in traffic volumes on Charlesgate East and West roadways would significantly impact the adjacent residential area.
- The increase in Charlesgate traffic volumes would impact pedestrian east/west flows.
- A decrease in available traffic capacity from Storrow Drive over the Massachusetts Turnpike would cause traffic diversions to other local streets, specifically those in Kenmore Square.

**Figure 5-2**
**Reconstruction of Bowker Bridge over the Massachusetts Turnpike**

**Figure 5-3**
**Charlesgate East Widening**


**Figure 5-4**
**Charlesgate West**


## 5.2.2 Bowker Overpass Alternative 2: Bowker Overpass At-Grade

Bowker Overpass Alternative 2 eliminates the overpass from the Massachusetts Turnpike to Storrow Drive. Figure 5-5 provides a conceptual design of the proposed alternative.

The alternative's basic concept is to replace the flyover connection with a new at-grade roadway between the Massachusetts Turnpike and Storrow Drive. Charlesgate East and West roadways would also be reconstructed.

Bowker Overpass Alternative 2 constructs a new bridge over the Massachusetts Turnpike (as shown in Figure 5-5), a new at-grade roadway in place of the overpass,

and new ramp connections to Storrow Drive. The bridge and the at-grade roadway would require six lanes, three lanes in each direction. By introducing a new at-grade roadway (in place of the overpass), three new signalized intersections would be constructed.

The Storrow Drive ramp connections would be reconstructed to provide access to/from the new at-grade roadway (as shown in Figure 5-6). Access to/from Storrow Drive would no longer be provided by Charlesgate East and West. Charlesgate East and West, north of Beacon Street, would only provide local access to its adjacent properties. These roadways would be reduced to one travel lane, with the addition of new bicycle lanes.

Only right turns would be allowed at the three new intersections. Left turns would be accommodated at the Commonwealth Avenue, Beacon Street, and Charlesgate East and West intersections (as shown in Figure 5-7).

While there are benefits to the proposed Bowker Overpass Alternative 2, there are a number of issues and impacts associated with it. The list below provides a summary of the benefits and issues/impacts of the alternative:

- The reconstructed bridge over the Massachusetts Turnpike and the reconstructed Charlesgate East and West roadways provide an opportunity to improve north-south pedestrian and bicycle accommodations.
- The reconstructed bridge over the Massachusetts Turnpike and the reconstructed Charlesgate East and West roadways moves traffic volumes away from adjacent residences on Charlesgate East and West.
- The new at-grade roadway creates a new east/west barrier for pedestrians and bicyclists due to high traffic volumes.
- The new at-grade roadway increases the impact to the park's open space.
- Other than the Charlesgate Greenway Connection, alternative 2 does not improve access to the Charles River and pathways.
- Alternative 2 increases delays and conflicts to vehicles, pedestrians, and bicyclists with the introduction of three new signalized intersections.

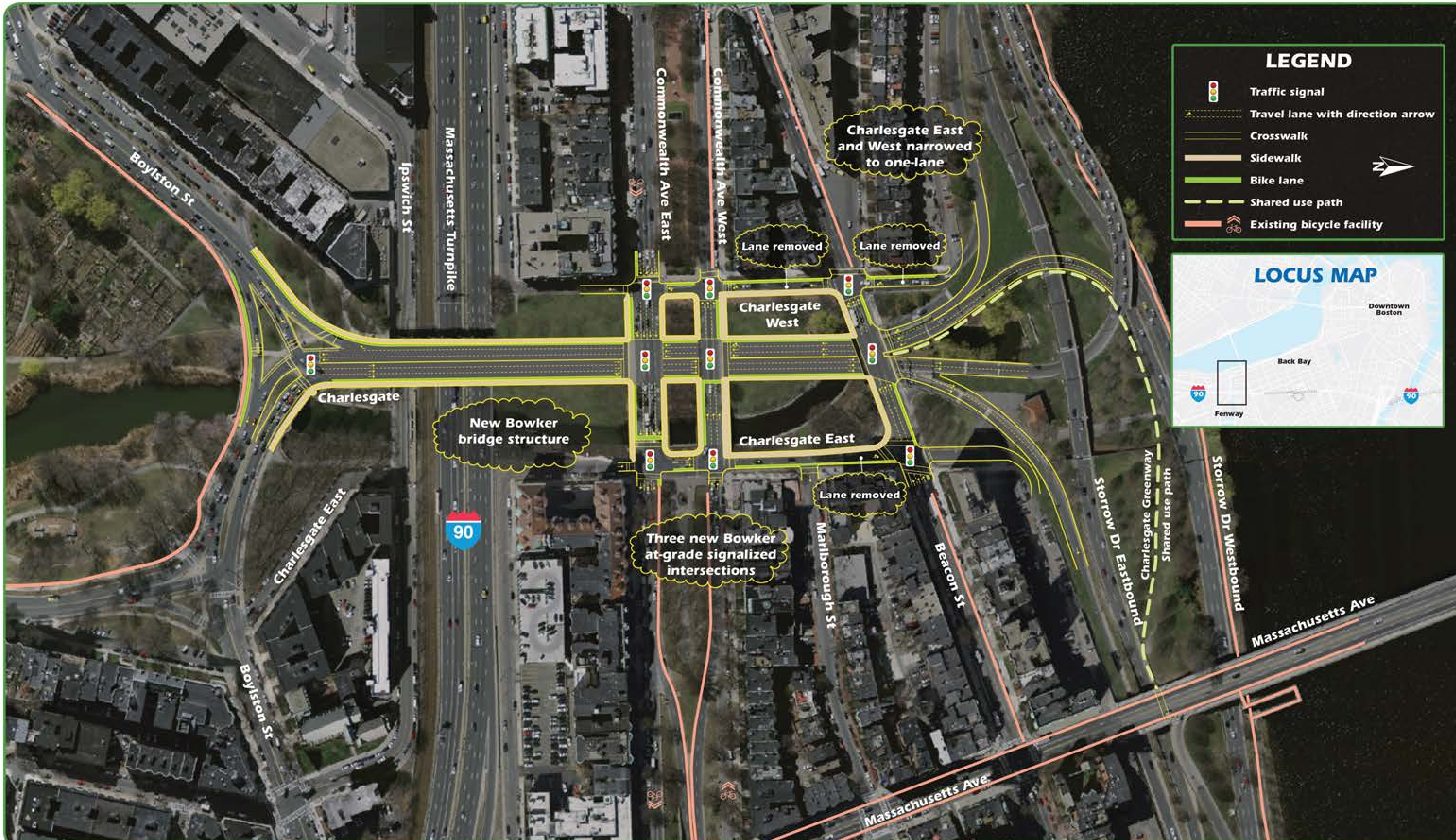



**FIGURE 5-5**
**Bowker Alternative 2**
**Bowker Overpass At-grade**

**Figure 5-6**
**New Storrow Drive Ramp Connections**

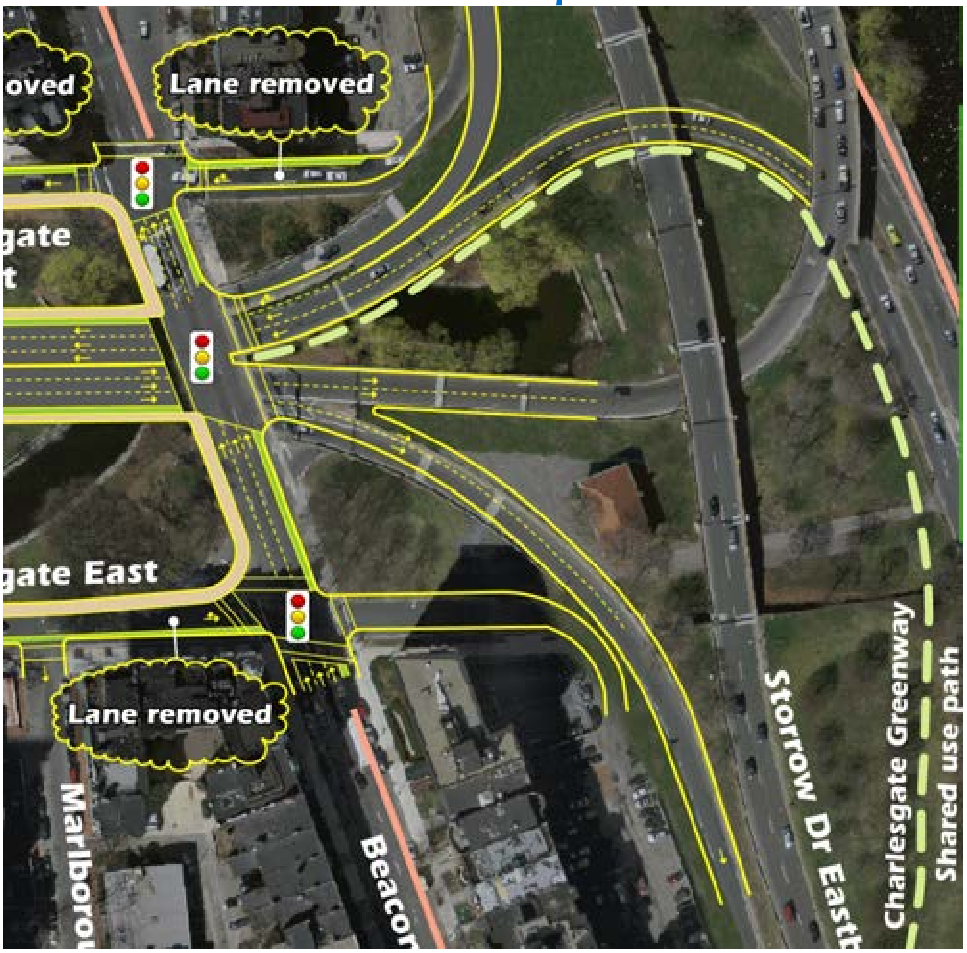
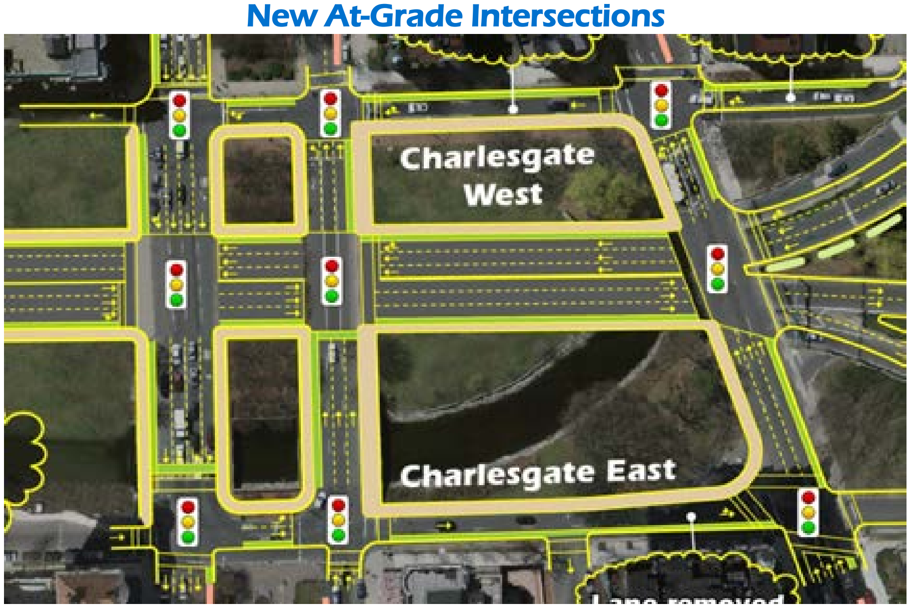



**Figure 5-7**
**New At-Grade Intersections**



### 5.2.3 Bowker Overpass Alternative 3: New Regional Access

Bowker Overpass Alternative 3 constructs a new Massachusetts Turnpike interchange and eliminates the overpass from the Massachusetts Turnpike to Storrow Drive. Figure 5-8 provides a conceptual design of the proposed alternative.

This alternative constructs a new full interchange (providing on and off ramps to the Massachusetts Turnpike in both directions) at the Bowker Overpass bridge. This interchange would provide new regional access to the Fenway neighborhood and Longwood Medical areas, as well as portions of Back Bay. The existing Bowker Overpass from the Massachusetts Turnpike to Storrow Drive would be removed, and there would no longer be a connection from Storrow Drive to Boylston Street and the Fenway neighborhood and Longwood Medical Area. Storrow Drive would only provide access to these areas via other streets, such Massachusetts Avenue and those around Kenmore Square.

The existing Bowker Overpass bridge over the Massachusetts Turnpike would be reconstructed into a diamond interchange configuration to provide east and west access to the Massachusetts Turnpike. The new interchange requires the reconstruction of the Massachusetts Turnpike from approximately Brookline Avenue to Massachusetts Avenue. The Massachusetts Turnpike would be shifted northward significantly (as shown in Figure 5-9). This northward shift would impact the properties along Newbury Street, and because of the northward shift and the new westbound off-ramp, the existing Massachusetts Avenue westbound on-ramp would need to be removed.

The Boylston Street and Charlesgate intersection would be reconstructed to provide a new left turn from Charlesgate to Boylston Street (as shown in Figure 5-10). This reconstructed intersection would be coordinated with the two new signalized intersections at the new Bowker Bridge and the on/off Massachusetts Turnpike ramps. All of the intersections would provide access/egress to the new Massachusetts Turnpike on/off ramps.

Pedestrian and bicycle accommodations would be added over the Massachusetts Turnpike. These accommodations would connect with pedestrian and bicycle ramps at the northern end of the bridge and also would connect with a new shared-use path to Commonwealth Avenue.

While there are benefits to the proposed Bowker Overpass Alternative 3, there are a number of issues and impacts associated with it. The list below provides a summary of the benefits and issues/impacts of the alternative:

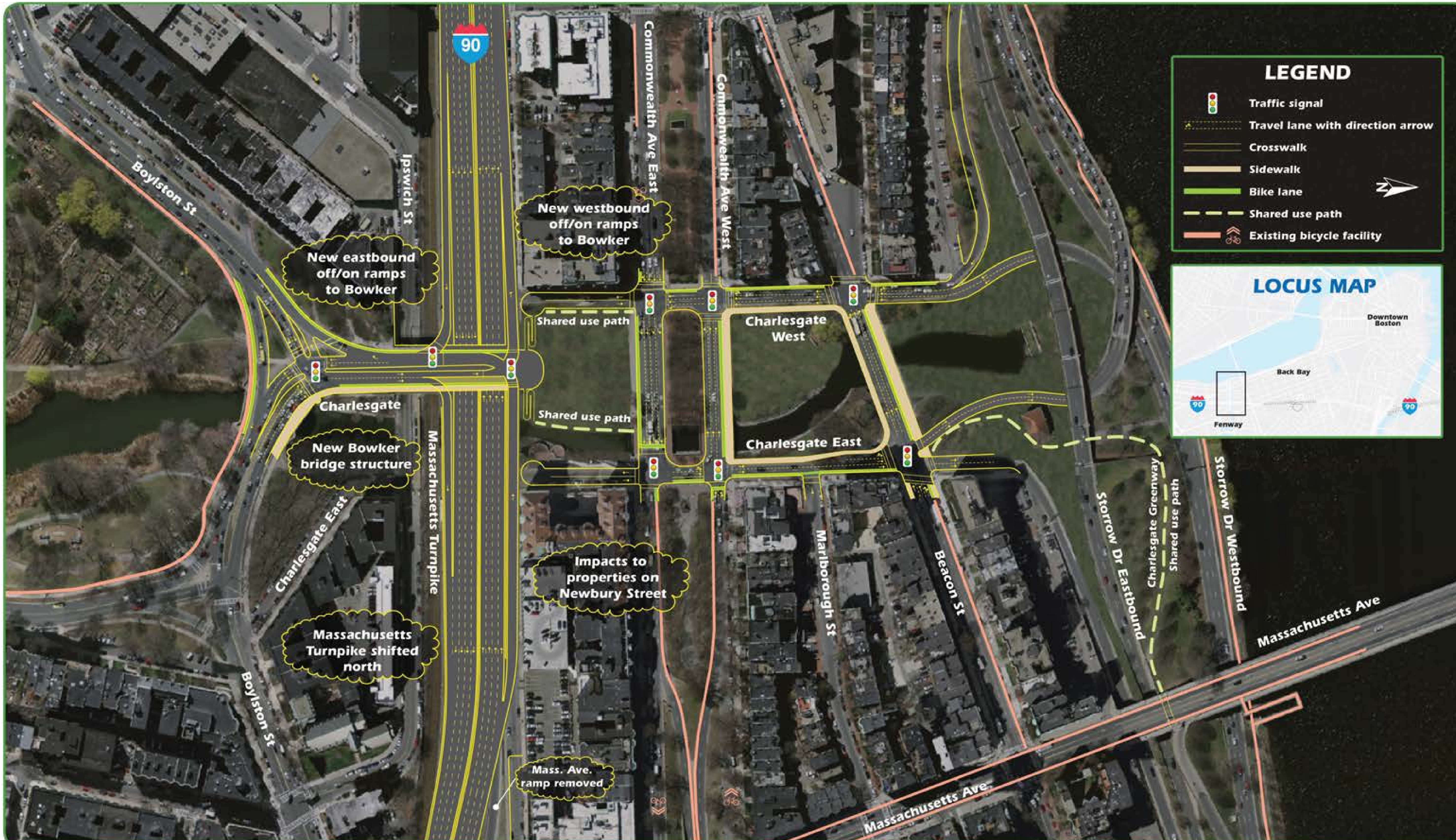
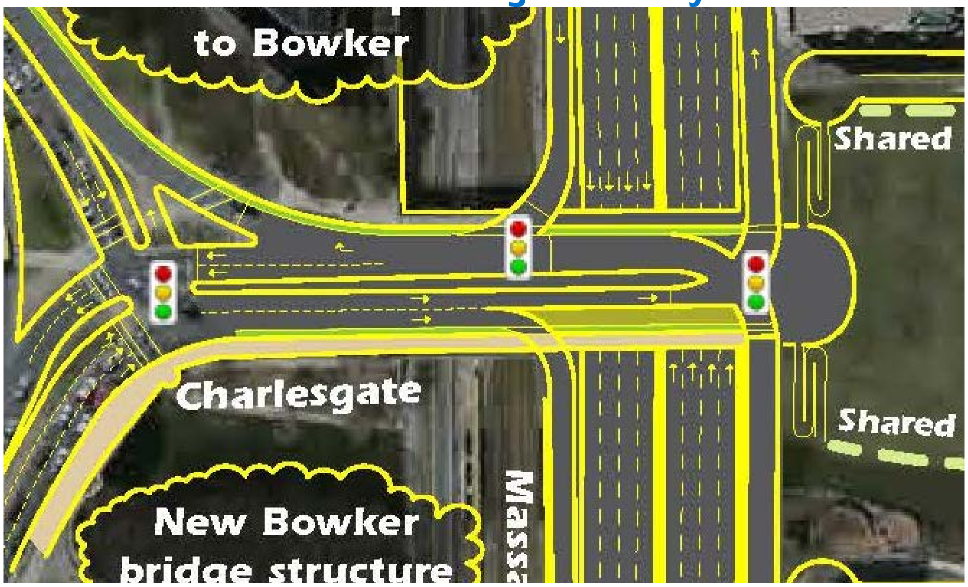



**FIGURE 5-8**
**Bowker Alternative 3**
**New Regional Access**

- The reconstructed bridge over the Massachusetts Turnpike provides an opportunity to improve north-south pedestrian and bicycle accommodations.
- The reconstructed bridge provides new regional access from the Massachusetts Turnpike.
- By removing the Bowker Overpass, the park's open space is increased.
- By shifting the Massachusetts Turnpike northward, the properties along Newbury Street are significantly impacted by the new on- and off-ramps.
- By removing the Bowker Overpass, the removal of the existing Massachusetts Avenue westbound on-ramp is required.
- Other than the Charlesgate Greenway Connection, Alternative 3 does not improve access to the Charles River and pathways.
- Alternative 3 increases diverted traffic from Storrow Drive to other routes.

**Figure 5-9**
**New Interchange with Massachusetts Turnpike Shifted**

**Figure 5-10**
**New Intersection at Charlesgate and Boylston Street**




## 5.2.4 Bowker Overpass Alternative 4: New Regional and Local Access

Bowker Overpass Alternative 4 constructs a new Massachusetts Turnpike interchange; eliminates the overpass from the Massachusetts Turnpike to Storrow Drive; and constructs a new diamond interchange at Storrow Drive and Massachusetts Avenue. Figure 5-11 provides a conceptual design of the proposed alternative.

Similar to Bowker Overpass Alternative 3, this alternative constructs a new full interchange at the Bowker Overpass Bridge and the Massachusetts Turnpike. This interchange would provide regional access to the Fenway neighborhood and Longwood Medical areas, with nearby access to Back Bay. In addition to the Massachusetts Turnpike interchange, a diamond interchange would be constructed at the intersection of Storrow Drive and Massachusetts Avenue (as shown in Figure 5-12).

Storrow Drive would be reconstructed to straighten its alignment and future designs could provide an improved connection to the Charles River and its multi-use path. The proposed Charlesgate Greenway Connection is shown with this alternative.

The existing section of the Bowker Overpass from the Massachusetts Turnpike to Storrow Drive would be removed, and there would no longer be a connection from Storrow Drive to Boylston Street and the Fenway neighborhood and Longwood Medical Area. Vehicles would use the Storrow Drive/Massachusetts Avenue interchange to access these areas via other streets, such as Massachusetts Avenue and those around Kenmore Square.

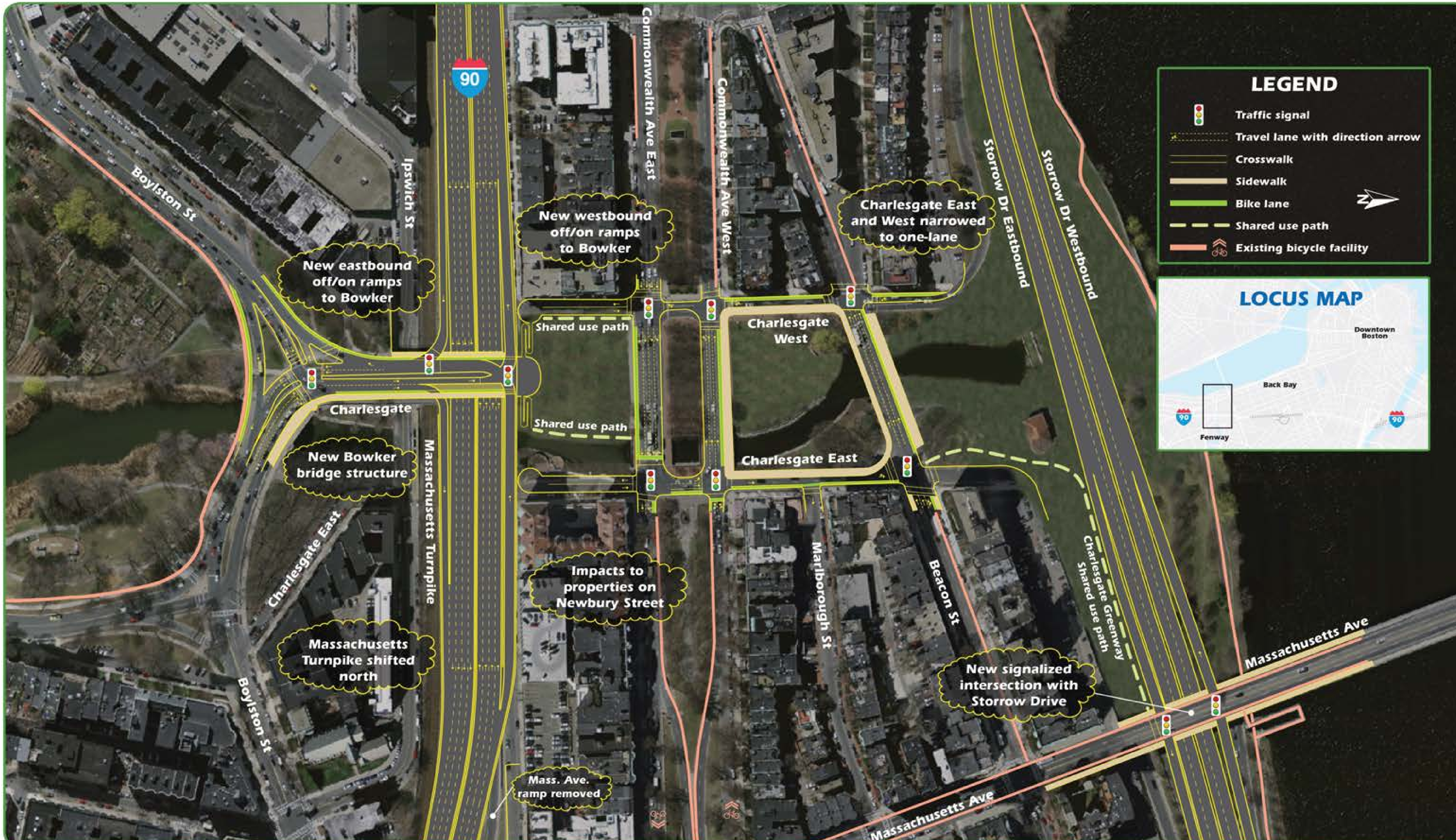



**FIGURE 5-11**
**Bowker Alternative 4**
**New Regional and Local Access**

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A benefit of this alternative is increased access to the Charles River for area residents. By realigning Storrow Drive and removing the Bowker Overpass and the Storrow Drive ramps, this alternative provides increased open space for the park and improves access to the Charles River and its multi-use path (as shown in Figure 5-13).

While there are benefits to the proposed Bowker Overpass Alternative 4, there are a number of issues and impacts associated with it. The list below provides a summary of the benefits and issues/impacts of the alternative:

- The reconstructed bridge over the Massachusetts Turnpike provides an opportunity to improve pedestrian and bicycle accommodations.
- The alternative provides new regional access from the Massachusetts Turnpike.
- The removal of the Bowker Overpass increases the park's open space.
- The Storrow Drive realignment increases the park's open space and provides an opportunity to improve access to the Charles River and its multi-use pathway.
- The alternative maintains access from Storrow Drive to the Back Bay, Fenway, and Longwood Medical areas.
- The alternative constructs new signalized intersections on the heavily traveled Massachusetts Avenue, which will cause additional congestion and delays as well as increase conflicts between vehicles, pedestrians, and bicyclists.
- The alternative increases diverted traffic from Storrow Drive to Massachusetts Avenue and the streets around Kenmore Square.

**Figure 5-12**
**New Interchange – Storrow Drive and Massachusetts Avenue**

**Figure 5-13**
**Realignment of Storrow Drive and Park Open Space**


## 5.3 BICYCLE AND PEDESTRIAN ACCOMMODATIONS-AREAS FOR IMPROVEMENT

The Bowker Overpass crosses perpendicularly over a grid of streets and avenues. It provides a connection in the north-south direction across the area, and allows cars, pedestrians, and bicycles to travel below it uninhibited (primarily in an east-west direction) While the primary traffic direction is east-west, there is considerable car, pedestrian, and bicycle traffic traveling northbound and southbound.

There is also significant bicycle and pedestrian usage in the east-west movement, which parallels the Commonwealth Mall. All of the sidewalks are at least 10 feet wide and there is landscaping in much of the area, which provides a buffer between the

cars and pedestrians. Additionally, new pedestrian signals recently have been installed, and most of the Bowker area streets are wide enough to include dedicated bicycle lanes or sharrows for the bicyclists throughout the study area.

The Charlesgate Greenway Shared Use Path—considered vital to the area's overall bicycle and pedestrian environment—would improve north-south pedestrian and bicycle traffic by connecting the Charlesgate Greenway to Storrow Drive. The proposed pedestrian/bicycle trail would connect at the intersection of Charlesgate East and Beacon Street. It would then travel north under the Storrow Drive overpass, through the grassy area, and would meet the roadway at Massachusetts Avenue as shown in Figure 5-12.

# Chapter 6—Future-Year Alternative Analysis: Massachusetts Turnpike Ramps

## 6.1 INTRODUCTION

This chapter describes the analysis of the future-year transportation conditions for the Massachusetts Turnpike Ramps during a typical workday, emphasizing the peak commuting hours. Staff used the Boston regional model to forecast AM and PM peak hour volumes in 2035 for each of the four study alternatives; then applied the volumes to I-90, selected arterials, and selected intersections to determine their performance under each scenario. The performance measures analyzed included speed, density (passenger cars/mile/lane), and level of service (LOS). Staff used two software packages to evaluate each of the alternatives' operations:

- Highway Capacity Software (HCS) 2010—a traffic analysis software based on the Highway Capacity Manual—to evaluate performance
- Synchro—a traffic capacity and simulation program developed and distributed by Trafficware Ltd.—to perform capacity analysis for an individual intersection or a series of intersections in a roadway network

Noise analysis also was conducted to evaluate the potential sound levels associated with changes in roadway alignments and vehicular traffic using the Federal Highway Administration's Traffic Noise Model Version 2.5. A memorandum detaining the noise analysis is provided in Appendix B to this report.

## 6.2 I-90 MAINLINE RESULTS

As shown in Table 6-1, there was no significant change in the I-90 performance measures among the scenarios in either the AM or PM peak hours. The only slight change was that in the westbound direction between the Prudential Tunnel and Exit 20 (Allston), LOS changed from C to B under Alternative 3; however, this reflects a decrease in density of only one car/mile/lane, showing that the LOS C measure in the other alternatives was close to the B-C threshold.

## 6.3 I-90 RAMP RESULTS

How traffic merges and diverges at on- and off-ramps also was analyzed, as shown in Tables 6-2 and 6-3. The most significant change at the ramps occurs in the westbound direction at Exit 25, I-93, where LOS improves from F in the 2035 No Build AM peak hour to LOS C in Alternatives 1 and 2. There are a few other minor shifts during the

AM peak hour at the South Boston on-ramp between Exits 24 and 25 in the westbound direction, and at Exit 20 for Allston-Brighton in the westbound direction. There were virtually no changes noted during the PM peak hour.

## 6.4 I-90 ARTERIAL RESULTS

Tables 6-4 and 6-5 show results for the study arterials under the various 2035 scenarios. During the AM period, the only two segments that change are eastbound on the Longfellow Bridge (Route 3) and westbound Storrow Drive between Longfellow Bridge and Leverett Circle. The Longfellow Bridge segment is rated LOS B under the 2035 No Build conditions but improves to LOS A in each of the other alternatives. The Storrow Drive segment is rated LOS E under the 2035 No Build conditions but improves to LOS D in each of the other alternatives.

During the PM period, the only two segments that change are southbound on the BU Bridge and northbound on the Harvard/Mass Ave Bridge. The BU Bridge is rated LOS C under the 2035 No Build conditions but improves to LOS B in each of the other alternatives. The Harvard/Mass Ave Bridge is LOS B under the 2035 No Build conditions but improves to LOS A in each of the other alternatives.

**TABLE 6-1**
**Level of Service I-90: Mainline Results for 2035 No Build and Alternatives**

| Location | Direction | 2035 No Build | | | 2035 Alternative 1 | | | 2035 Alternative 2 | | | 2035 Alternative 3 | | | 2035 Alternative 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS |
| AM PEAK PERIOD | | | | | | | | | | | | | | | | |
| I-90 EB between Prudential Tunnel and Allston Toll (Int 20) | EB | 62.1 | 29.8 | D | 62.7 | 28.8 | D | 62.7 | 28.8 | D | 62.7 | 28.8 | D | 63 | 28.1 | D |
| I-90 WB between Prudential Tunnel and Allston Toll (Int 20) | WB | 65.0 | 19.3 | C | 65.0 | 19 | C | 65.0 | 18.9 | C | 65.0 | 17.9 | B | 65.0 | 19.2 | C |
| I-90 EB between Prudential Tunnel and I-93 Exit (Int 24) | EB | 63.5 | 27.2 | D | 63.8 | 26.5 | D | 63.8 | 26.5 | D | 63.8 | 26.4 | D | 63.3 | 27.7 | D |
| I-90 WB between Prudential Tunnel and I-93 Exit (Int 24) | WB | 65.0 | 19.5 | C | 65.0 | 22.4 | C | 64.9 | 22.5 | C | 65.0 | 21.2 | C | 65.0 | 19.5 | C |
| I-90 EB in Ted Williams Tunnel | EB | 55.0 | 16.1 | B | 55.0 | 16.1 | B | 55.0 | 16 | B | 55.0 | 16 | B | 55.0 | 16.3 | B |
| I-90 WB in Ted Williams Tunnel | WB | 55.0 | 26.4 | D | 55.0 | 26.8 | D | 55.0 | 26.9 | D | 55.0 | 26.5 | D | 55.0 | 26.1 | D |
| PM PEAK PERIOD | | | | | | | | | | | | | | | | |
| I-90 EB between Prudential Tunnel and Allston Toll (Int 20) | EB | 65 | 21.2 | C | 65 | 21.1 | C | 65 | 21 | C | 65 | 21.1 | C | 65 | 20.6 | C |
| I-90 WB between Prudential Tunnel and Allston Toll (Int 20) | WB | 64.6 | 24.4 | C | 64.8 | 23.2 | C | 65.0 | 22.3 | C | 64.2 | 25.6 | C | 64.7 | 23.8 | C |
| I-90 EB between Prudential Tunnel and I-93 Exit (Int 24) | EB | 65 | 21 | C | 65 | 20.9 | C | 65 | 20.9 | C | 65 | 20.9 | C | 65 | 22 | C |
| I-90 WB between Prudential Tunnel and I-93 Exit (Int 24) | WB | 65.0 | 22.1 | C | 64.6 | 24.3 | C | 64.6 | 24.3 | C | 64.8 | 23.3 | C | 65.0 | 21.6 | C |
| I-90 EB in Ted Williams Tunnel | EB | 55.0 | 32.2 | D | 55.0 | 31.8 | D | 55.0 | 31.8 | D | 55.0 | 31.9 | D | 55.0 | 31.9 | D |
| I-90 WB in Ted Williams Tunnel | WB | 55.0 | 23.4 | C | 55.0 | 23.9 | C | 55.0 | 23.9 | C | 55.0 | 23.9 | C | 55.0 | 23.8 | C |

## TABLE 6-2
## Level of Service I-90: Ramp Results for 2035 No Build and Alternatives

| Location | Direction | Merge or Diverge | 2035 No Build | | | 2035 Alternative 1 | | | 2035 Alternative 2 | | | 2035 Alternative 3 | | | 2035 Alternative 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS |
| AM PEAK PERIOD | | | | | | | | | | | | | | | | | |
| I-90 EB Int 20 Allston-Brighton | EB | Merge | Merge has acceptable operations because of geometry, LOS not used. | | | | | | | | | | | | | | |
| *Alternative 4: I-90 EB Bowker Overpass On-ramp* | EB | Merge | | | | | | | | | | | | | 56.0 | 29.2 | D |
| I-90 EB Int 22 Prudential-Copley Off-ramp | EB | Diverge | 46.9 | 21.4 | C | 46.9 | 20.5 | C | 47.0 | 20.4 | C | 46.9 | 20.5 | C | 46.9 | 21.5 | C |
| I-90 EB Int24 I-93/South Station Off-ramp | EB | Diverge | 48.7 | 29.1 | D | 48.9 | 28.1 | D | 48.9 | 28.1 | D | 48.9 | 28.0 | C | 48.7 | 29.4 | D |
| I-90 EB Exit 25 South Boston Off-ramp | EB | Diverge | 48.2 | 16.7 | B | 48.2 | 16.8 | B | 48.2 | 16.8 | B | 48.2 | 16.8 | B | 48.2 | 17.4 | B |
| I-90 EB I-93 NB On-ramp | EB | Merge | 51.0 | 12.8 | B | 51.0 | 12.9 | B | 51.0 | 12.9 | B | 51.0 | 12.9 | B | 51.0 | 13.2 | B |
| I-90 EB South Boston On-ramp | EB | Merge | 51.0 | 16.6 | B | 51.0 | 16.6 | B | 51.0 | 16.6 | B | 51.0 | 16.6 | B | 51.0 | 16.9 | B |
| I-90 EB HOV from I-93 On-ramp | EB | Merge | 51.0 | 16.1 | B | 51.0 | 16.1 | B | 51.0 | 16.0 | B | 51.0 | 16.0 | B | 51.0 | 16.2 | B |
| I-90 WB Exit 25 I-93/South Boston Off-ramp | WB | Diverge | 47.0 | 25.6 | F | 47.1 | 26.0 | C | 47.1 | 26.1 | C | 47.1 | 25.8 | F | 47.0 | 25.3 | F |
| I-90 WB South Boston On-ramp | WB | Merge | 51.0 | 9.4 | A | 51.0 | 11.1 | B | 51.0 | 11.1 | B | 51.0 | 10.4 | B | 51.0 | 9.3 | A |
| I-90 WB Int 24 I-93 NB On-ramp | WB | Merge | 50.0 | 24.6 | C | 50.0 | 26.7 | C | 50.0 | 26.8 | C | 50.0 | 26.0 | C | 50.0 | 24.6 | C |
| I-90 WB Int 24 I-93 SB On-ramp | WB | Merge | Merge has acceptable operations because of geometry, LOS not used. | | | | | | | | | | | | | | |
| I-90 WB Int 23 Arlington Street On-ramp | WB | Merge | 57.0 | 23.9 | C | Closed in this Alternative | | | Closed in this Alternative | | | 56.0 | 25.7 | C | 57.0 | 23.9 | C |
| *Alternative 1: I-90 WB Berkeley Street Off-ramp* | WB | Diverge | | | | 48.9 | 24.9 | C | | | | | | | | | |
| *Alternative 2: I-90 WB Stuart Street/Trinity Place Off-ramp* | WB | Diverge | | | | | | | 48.8 | 25.1 | C | | | | | | |
| I-90 WB Clarendon Street On-ramp | WB | Merge | 23.4 | C | 57.0 | 22.4 | C | 23.4 | Closed in this Alternative | | | 57.0 | 25.2 | C | 57.0 | 23.4 | C |
| I-90 WB Int 22 Prudential-Copley On-ramp | WB | Merge | Merge has acceptable operations because of geometry, LOS not used. | | | | | | | | | | | | | | |
| I-90 WB Int 21 Massachusetts Avenue On-ramp | WB | Merge | 57.0 | 22.2 | C | 57.0 | 22.1 | C | 58.0 | 13.6 | B | 57.0 | 23.8 | C | 57.0 | 22.2 | C |
| *Alternative 3: I-90 WB Brookline Avenue Off-ramp* | WB | Diverge | | | | | | | | | | 48.5 | 24.2 | C | | | |
| I-90 WB Int 20 Allston-Brighton | WB | Diverge | 51.5 | 10.2 | B | 51.5 | 9.8 | A | 51.5 | 9.6 | A | 51.4 | 10.0 | A | 51.5 | 10.1 | B |

**TABLE 6-3**
**Level of Service I-90: Ramp Results for 2035 No Build and Alternatives**

| Location | Direction | Merge or Diverge | 2035 No Build | | | 2035 Alternative 1 | | | 2035 Alternative 2 | | | 2035 Alternative 3 | | | 2035 Alternative 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS |
| PM PEAK PERIOD | | | | | | | | | | | | | | | | | |
| I-90 EB Int 20 Allston-Brighton | EB | Merge | Merge has acceptable operations because of geometry, LOS not used. | | | | | | | | | | | | | | |
| *Alternative 4: I-90 EB Bowker Overpass On-ramp* | EB | Merge | | | | | | | | | | | | | 57.0 | 24.1 | C |
| I-90 EB Int 22 Prudential-Copley Off-ramp | EB | Diverge | 47.8 | 12.1 | B | 47.8 | 11.8 | B | 47.8 | 11.8 | B | 47.8 | 12.0 | B | 47.7 | 13.1 | B |
| I-90 EB Int 24 I-93/South Station Off-ramp | EB | Diverge | 50.0 | 19.2 | B | 50.0 | 19.2 | B | 50.0 | 19.2 | B | 50.0 | 19.2 | B | 49.9 | 20.6 | C |
| I-90 EB Exit 25 South Boston Off-ramp | EB | Diverge | 48.7 | 16.9 | B | 48.7 | 16.7 | B | 48.7 | 16.7 | B | 48.7 | 16.7 | B | 48.7 | 17.6 | B |
| I-90 EB I-93 NB On-ramp | EB | Merge | 51.0 | 20.9 | C | 51.0 | 20.6 | C | 51.0 | 20.6 | C | 51.0 | 20.7 | C | 51.0 | 21.0 | C |
| I-90 EB South Boston On-ramp | EB | Merge | 50.0 | 29.3 | D | 50.0 | 28.9 | D | 50.0 | 28.9 | D | 50.0 | 29.0 | D | 50.0 | 29.2 | D |
| I-90 EB HOV from I-93 On-ramp | EB | Merge | 50.0 | 29.9 | D | 50.0 | 29.5 | D | 50.0 | 29.5 | D | 50.0 | 29.6 | D | 50.0 | 29.6 | D |
| I-90 WB Exit 25 I-93/South Boston Off-ramp | WB | Diverge | 47.4 | 22.8 | C | 47.5 | 23.2 | C | 47.5 | 23.2 | C | 47.5 | 23.2 | C | 47.4 | 23.1 | C |
| I-90 WB South Boston On-ramp | WB | Merge | 51.0 | 12.3 | B | 51.0 | 13.7 | B | 51.0 | 13.8 | B | 51.0 | 13.5 | B | 51.0 | 12.5 | B |
| I-90 WB Int 24 I-93 NB On-ramp | WB | Merge | 50.0 | 25.4 | C | 50.0 | 27.4 | C | 50.0 | 27.4 | C | 50.0 | 26.7 | C | 50.0 | 25.6 | C |
| I-90 WB Int 24 I-93 SB On-ramp | WB | Merge | Merge has acceptable operations because of geometry, LOS not used. | | | | | | | | | | | | | | |
| I-90 WB Int 23 Arlington Street On-ramp | WB | Merge | 56.0 | 28.5 | D | Closed in this Alternative | | | Closed in this Alternative | | | 56.0 | 29.2 | D | 56.0 | 27.8 | C |
| *Alternative 1: I-90 WB Berkeley Street Off-ramp* | WB | Diverge | | | | 48.8 | 26.5 | C | | | | | | | | | |
| *Alternative 2: I-90 WB Stuart Street/Trinity Place Off-ramp* | WB | Diverge | | | | | | | 48.9 | 26.4 | C | | | | | | |
| I-90 WB Clarendon Street On-ramp | WB | Merge | 56.0 | 28.3 | D | 56.0 | 26.9 | C | Closed in this Alternative | | | 56.0 | 29.1 | D | 56.0 | 28.1 | D |
| I-90 WB Int. 22 Prudential-Copley On-ramp | WB | Merge | Merge has acceptable operations because of geometry, LOS not used. | | | | | | | | | | | | | | |
| I-90 WB Int 21 Massachusetts Avenue On-ramp | WB | Merge | 56.0 | 26.5 | C | 56.0 | 25.6 | C | 57.0 | 24.9 | C | 56.0 | 27.5 | C | 56.0 | 26.0 | C |
| *Alternative 3: I-90 WB Brookline Avenue Off-ramp* | WB | Diverge | | | | | | | | | | 49.4 | 24.7 | C | | | |
| I-90 WB Int 20 Allston-Brighton | WB | Diverge | 51.2 | 14.6 | B | 51.3 | 13.3 | B | 51.3 | 13.0 | B | 51.4 | 14.3 | B | 51.2 | 14.0 | B |

**TABLE 6-4**
**Level of Service I-90: Arterial Results for 2035 No Build and Alternatives**

| Location | Direction | 2035 No Build | | | 2035 Alternative 1 | | | 2035 Alternative 2 | | | 2035 Alternative 3 | | | 2035 Alternative 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS |
| AM PEAK PERIOD | | | | | | | | | | | | | | | | |
| Boston University Bridge (Route 2) | NB | 45.0 | 20.3 | C | 45.0 | 19.5 | C | 45.0 | 19.4 | C | 45.0 | 19.6 | C | 45.0 | 19.6 | C |
| Boston University Bridge (Route 2) | SB | 45.0 | 13.3 | B | 45.0 | 13.1 | B | 45.0 | 13.1 | B | 45.0 | 12.9 | B | 45.0 | 13.1 | B |
| Harvard Bridge (Route 2A) | NB | 45.0 | 15.9 | B | 45.0 | 15.1 | B | 45.0 | 15.1 | B | 45.0 | 15.0 | B | 45.0 | 14.7 | B |
| Harvard Bridge (Route 2A) | SB | 45.0 | 9.1 | A | 45.0 | 8.6 | A | 45.0 | 8.5 | A | 45.0 | 8.3 | A | 45.0 | 8.8 | A |
| Longfellow Bridge (Route 3) | EB | 45.0 | 11.1 | B | 45.0 | 10.4 | A | 45.0 | 10.4 | A | 45.0 | 10.5 | A | 45.0 | 10.4 | A |
| Longfellow Bridge (Route 3) | WB | 45.0 | 12.0 | B | 45.0 | 12.2 | B | 45.0 | 12.2 | B | 45.0 | 12.2 | B | 45.0 | 12.2 | B |
| Memorial Drive (Route 3) between BU Bridge and Harvard Bridge | EB | 45.0 | 25.0 | C | 45.0 | 24.6 | C | 45.0 | 23.7 | C | 45.0 | 23.8 | C | 45.0 | 24.1 | C |
| Memorial Drive (Route 3) between BU Bridge and Harvard Bridge | WB | 45.0 | 13.2 | B | 45.0 | 12.6 | B | 45.0 | 12.6 | B | 45.0 | 12.8 | B | 45.0 | 13 | B |
| Memorial Drive (Route 3) between Harvard Bridge and Longfellow Bridge | EB | 45.0 | 25.0 | C | 45.0 | 23.3 | C | 45.0 | 24.5 | C | 45.0 | 23.3 | C | 45.0 | 23.4 | C |
| Memorial Drive (Route 3) between Harvard Bridge and Longfellow Bridge | WB | 45.0 | 13.3 | B | 45.0 | 12.6 | B | 45.0 | 12.8 | B | 45.0 | 12.5 | B | 45.0 | 13 | B |
| Storrow Drive between Harvard Bridge and Berkeley Street | EB | 45.0 | 29.2 | D | 45.0 | 27.6 | D | 45.0 | 27.5 | D | 45.0 | 27.6 | D | 45.0 | 27.3 | D |
| Storrow Drive between Harvard Bridge and Berkeley Street | WB | 45.0 | 25.4 | C | 45.0 | 25.8 | C | 45.0 | 25.8 | C | 45.0 | 25.1 | C | 45.0 | 25.6 | C |
| Storrow Drive between Berkeley Street and Longfellow Bridge (Route 28) | EB | 45.0 | 30.0 | D | 45.0 | 28.4 | D | 45.0 | 28.4 | D | 45.0 | 28.4 | D | 45.0 | 28.4 | D |
| Storrow Drive between Berkeley Street and Longfellow Bridge (Route 28) | WB | 44.9 | 32.4 | D | 44.9 | 31.9 | D | 44.9 | 31.9 | D | 45.0 | 31.6 | D | 44.9 | 32.1 | D |
| Storrow Drive between Longfellow Bridge and Leverett Circle (Route 28) | EB | 45.0 | 19.2 | C | 45.0 | 18.8 | C | 45.0 | 18.9 | C | 45.0 | 18.9 | C | 45.0 | 18.8 | C |
| Storrow Drive between Longfellow Bridge and Leverett Circle (Route 28) | WB | 44.4 | 35.0 | E | 44.5 | 34.3 | D | 44.6 | 34.2 | D | 45.0 | 34.7 | D | 45.0 | 34.9 | D |
| Callahan Tunnel | NB | 45.0 | 20.4 | C | 45.0 | 20.4 | C | 45.0 | 20.5 | C | 45.0 | 20.4 | C | 45.0 | 20.3 | C |
| Sumner Tunnel | SB | 45.0 | 10 | A | 45.0 | 9.4 | A | 45.0 | 9.3 | A | 45.0 | 9.5 | A | 45.0 | 9.8 | A |

**TABLE 6-5**
**Level of Service I-90: Arterial Results for 2035 No Build and Alternatives**

| Location | Direction | 2035 No Build | | | 2035 Alternative 1 | | | 2035 Alternative 2 | | | 2035 Alternative 3 | | | 2035 Alternative 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS | Computed Speeds (MPH) | Passenger Cars/ Mile/Lane | LOS |
| PM PEAK PERIOD | | | | | | | | | | | | | | | | |
| Boston University Bridge (Route 2) | NB | 45.0 | 14.8 | B | 45.0 | 14 | B | 45.0 | 14 | B | 45.0 | 14 | B | 45.0 | 14 | B |
| Boston University Bridge (Route 2) | SB | 45.0 | 18.2 | C | 45.0 | 18 | B | 45.0 | 18 | B | 45.0 | 17.8 | B | 45.0 | 18.1 | B |
| Harvard Bridge (Route 2A) | NB | 45.0 | 12.0 | B | 45.0 | 10.8 | A | 45.0 | 10.8 | A | 45.0 | 10.8 | A | 45.0 | 10.4 | A |
| Harvard Bridge (Route 2A) | SB | 45.0 | 11.6 | B | 45.0 | 11.6 | B | 45.0 | 11.6 | B | 45.0 | 11.3 | B | 45.0 | 11.7 | B |
| Longfellow Bridge (Route 3) | EB | 45.0 | 16.3 | B | 45.0 | 16.6 | B | 45.0 | 16.6 | B | 45.0 | 16.5 | B | 45.0 | 16.6 | B |
| Longfellow Bridge (Route 3) | WB | 45.0 | 8.5 | A | 45.0 | 7.9 | A | 45.0 | 7.9 | A | 45.0 | 7.8 | A | 45.0 | 7.8 | A |
| Memorial Drive (Route 3) between BU Bridge and Harvard Bridge | EB | 45.0 | 12.1 | B | 45.0 | 12.2 | B | 45.0 | 12.2 | B | 45.0 | 12.2 | B | 45.0 | 12.4 | B |
| Memorial Drive (Route 3) between BU Bridge and Harvard Bridge | WB | 45.0 | 14.6 | B | 45.0 | 14.4 | B | 45.0 | 14.4 | B | 45.0 | 14.3 | B | 45.0 | 14.4 | B |
| Memorial Drive (Route 3) between Harvard Bridge and Longfellow Bridge | EB | 45.0 | 13.4 | B | 45.0 | 12.4 | B | 45.0 | 12.5 | B | 45.0 | 12.5 | B | 45.0 | 12.5 | B |
| Memorial Drive (Route 3) between Harvard Bridge and Longfellow Bridge | WB | 45.0 | 13.7 | B | 45.0 | 13.4 | B | 45.0 | 13.4 | B | 45.0 | 13.2 | B | 45.0 | 13.5 | B |
| Storrow Drive between Harvard Bridge and Berkeley Street | EB | 45.0 | 22.5 | C | 45.0 | 21.6 | C | 45.0 | 21.6 | C | 45.0 | 21.7 | C | 45.0 | 21.3 | C |
| Storrow Drive between Harvard Bridge and Berkeley Street | WB | 45.0 | 29.3 | D | 45.0 | 30 | D | 45.0 | 30 | D | 45.0 | 29.5 | D | 45.0 | 29.5 | D |
| Storrow Drive between Berkeley Street and Longfellow Bridge (Route 28) | EB | 45.0 | 24.8 | C | 45.0 | 23.4 | C | 45.0 | 24.8 | C | 45.0 | 24.8 | C | 45.0 | 23.2 | C |
| Storrow Drive between Berkeley Street and Longfellow Bridge (Route 28) | WB | 44.7 | 33.3 | D | 44.8 | 33.0 | D | 44.7 | 33.3 | D | 44.7 | 33.3 | D | 44.7 | 33.2 | D |
| Storrow Drive between Longfellow Bridge and Leverett Circle (Route 28) | EB | 45.0 | 19.8 | C | 45.0 | 19.1 | C | 45.0 | 19.1 | C | 45.0 | 19.1 | C | 45.0 | 19.0 | C |
| Storrow Drive between Longfellow Bridge and Leverett Circle (Route 28) | WB | 45.0 | 30.1 | D | 45.0 | 29.7 | D | 45.0 | 29.5 | D | 45.0 | 30.0 | D | 45.0 | 30.2 | D |
| Callahan Tunnel | NB | 45.0 | 20.7 | C | 45.0 | 20.2 | C | 45.0 | 20.3 | C | 45.0 | 20.2 | C | 45.0 | 20.2 | C |
| Sumner Tunnel | SB | 45.0 | 18.2 | C | 45.0 | 18 | C | 45.0 | 18 | C | 45.0 | 18.2 | C | 45.0 | 18.4 | C |

## 6.5 BACK BAY RAMP INTERSECTION RESULTS

The intersection analysis for the Back Bay Ramp alternatives was analyzed using Synchro for the AM and PM peak hours for selected intersections in the Boston area. Intersections selected are major intersections that surround Back Bay and help feed traffic into and out of the neighborhood. The following intersections were evaluated:

- Park Drive at Brookline Avenue/Boylston Street
- Kenmore Square
- Massachusetts Avenue at Beacon Street
- Massachusetts Avenue at Boylston Street
- Dartmouth Street at Saint James Avenue
- Berkeley Street at Columbus Avenue
- Arlington Street at Stuart Street/Columbus Avenue
- Berkeley Street at Saint James Avenue
- Berkeley Street at Beacon Street
- Arlington Street/Mugar Way at Beacon Street

The following additional intersections were analyzed based on the Back Bay Ramp alternative:

- New Ramp intersection: Stuart Street at Trinity Place
- New Ramp intersection: Off-Ramp at Brookline Avenue
- Bowker Overpass at Boylston Street
- Charlesgate at Bolyston Street and Fenway

As the results in Figures 6-1 through 6-8 show, the AM and PM peak period LOS and queuing does not change significantly at any of the key intersections. There are some improvements at intersections located near the proposed ramps. A summary table of all intersections analyzed is provided in Appendix C.

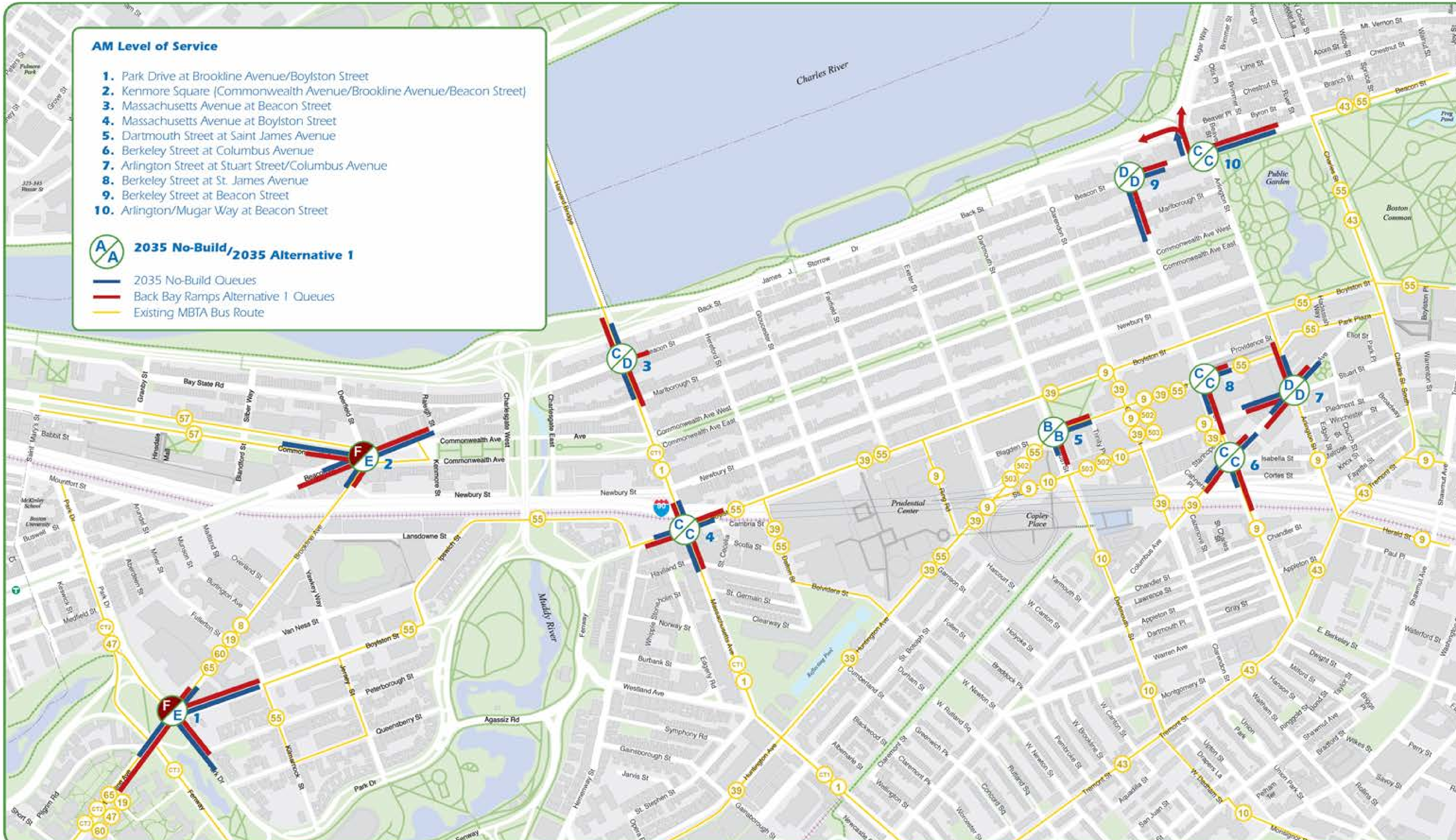



**FIGURE 6-1**
**Back Bay Ramps Alternative 1**
**New Westbound Off-Ramp to Berkeley Street: AM LOS**

massDOT
Massachusetts Department of Transportation
Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

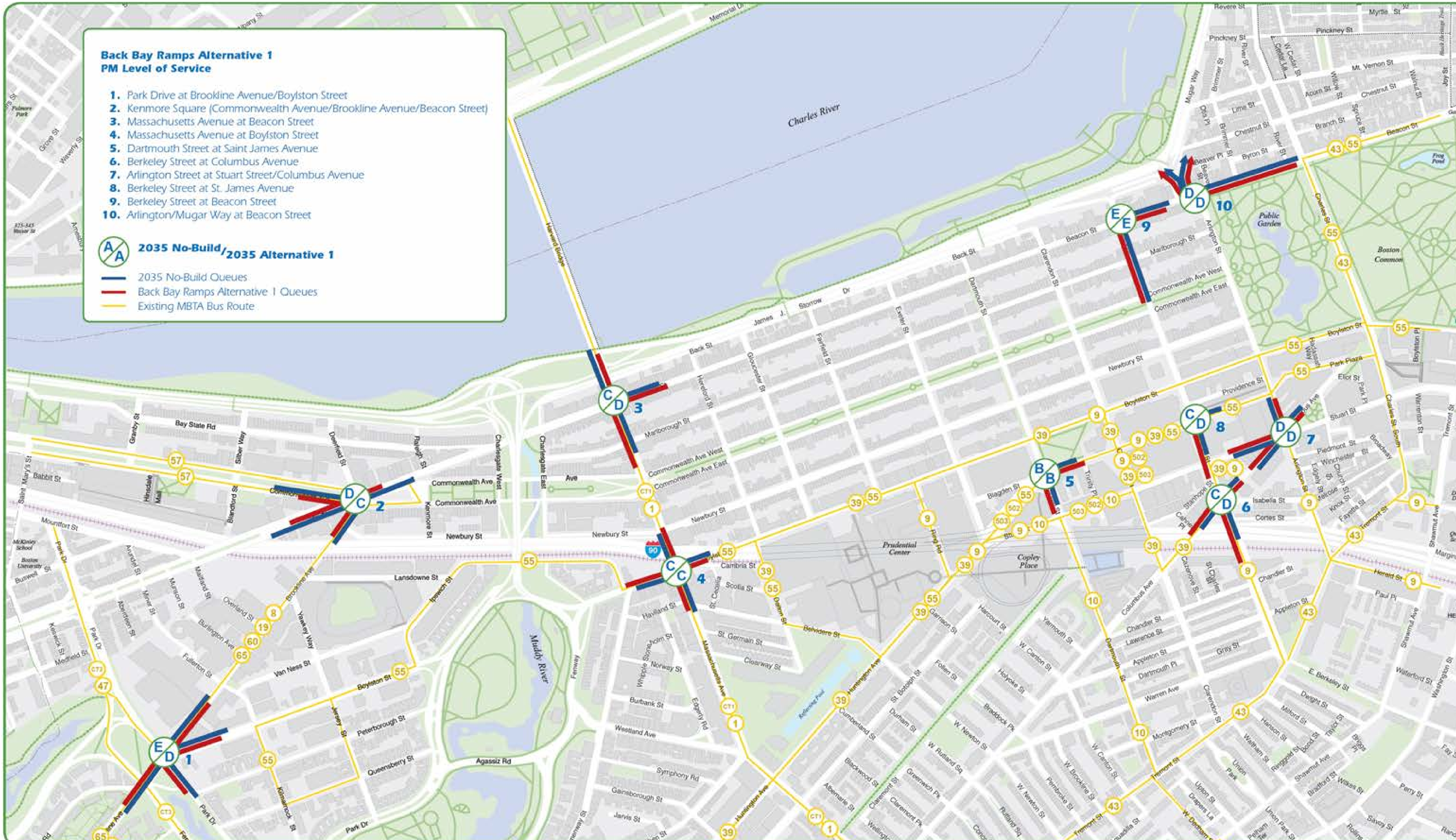



**FIGURE 6-2**
**Back Bay Ramps Alternative 1**
**New Westbound Off-Ramp to Berkeley Street: PM LOS**

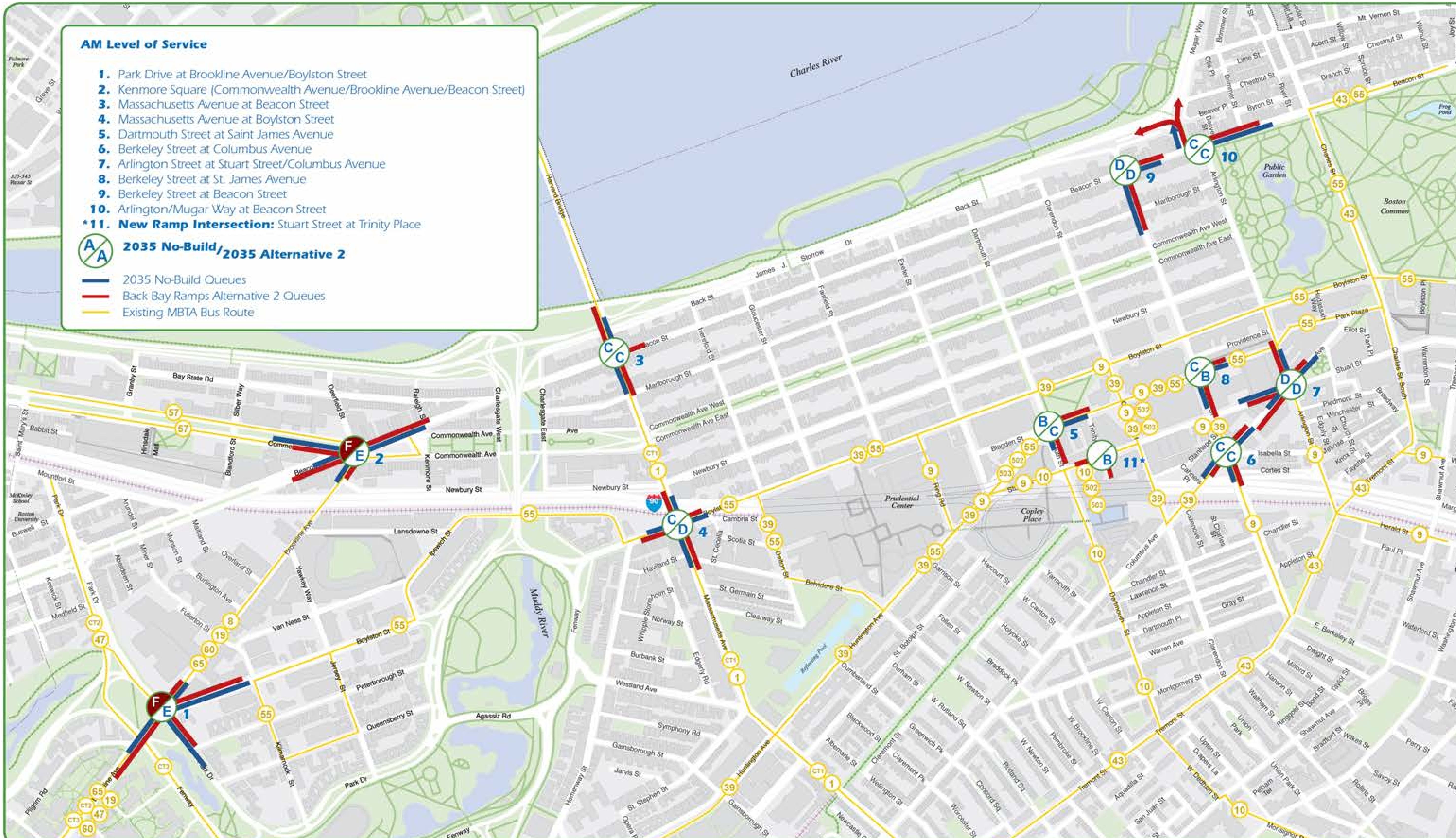



**FIGURE 6-3**
**Back Bay Ramps Alternative 2**
**New Westbound Off-Ramp to Trinity Place/Stuart Street: AM LOS**

massDOT
Massachusetts Department of Transportation
Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

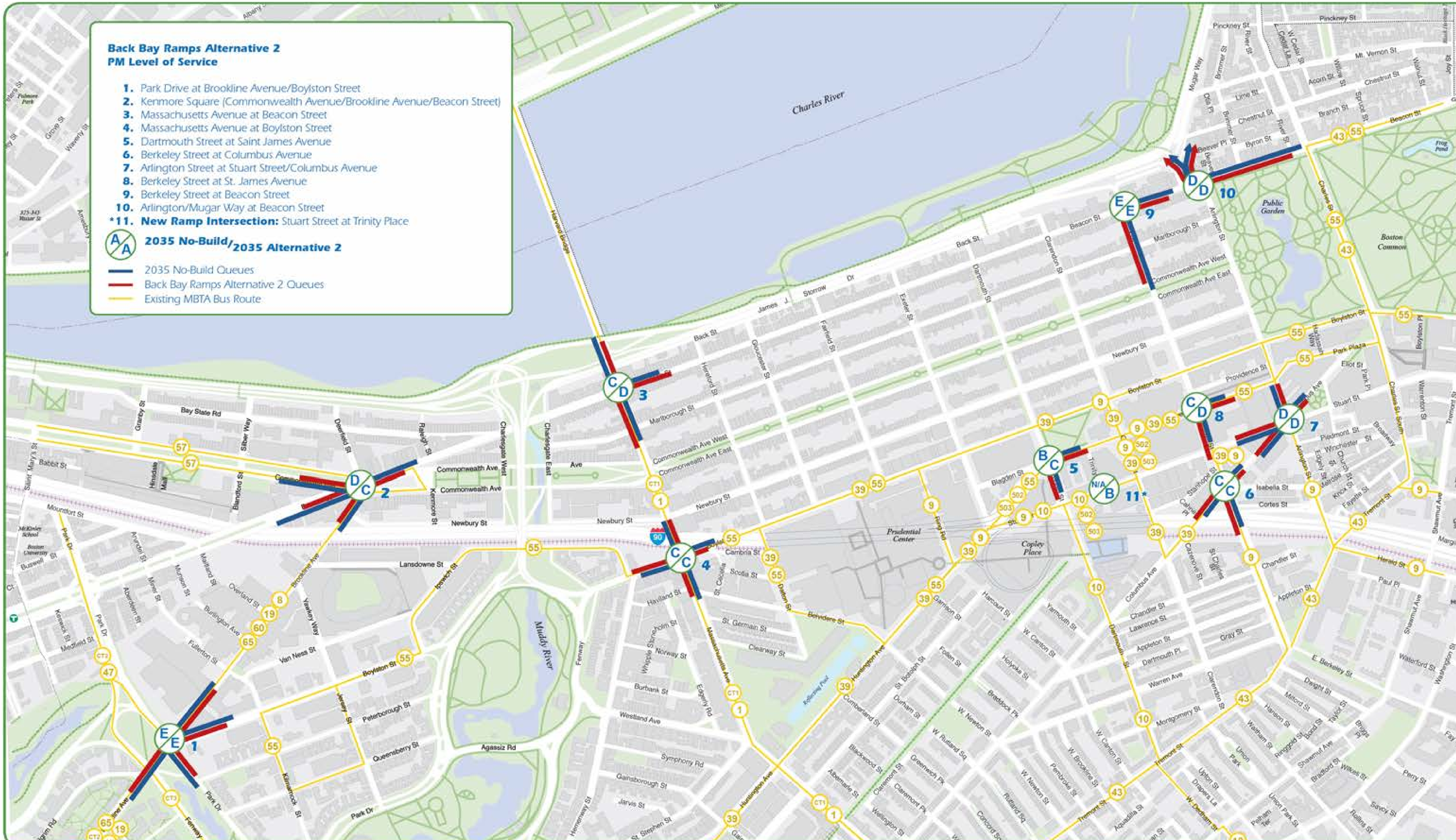



**FIGURE 6-4**
**Back Bay Ramps Alternative 2**
**New Westbound Off-Ramp to Trinity Place/Stuart Street: PM LOS**

massDOT
Massachusetts Department of Transportation
Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

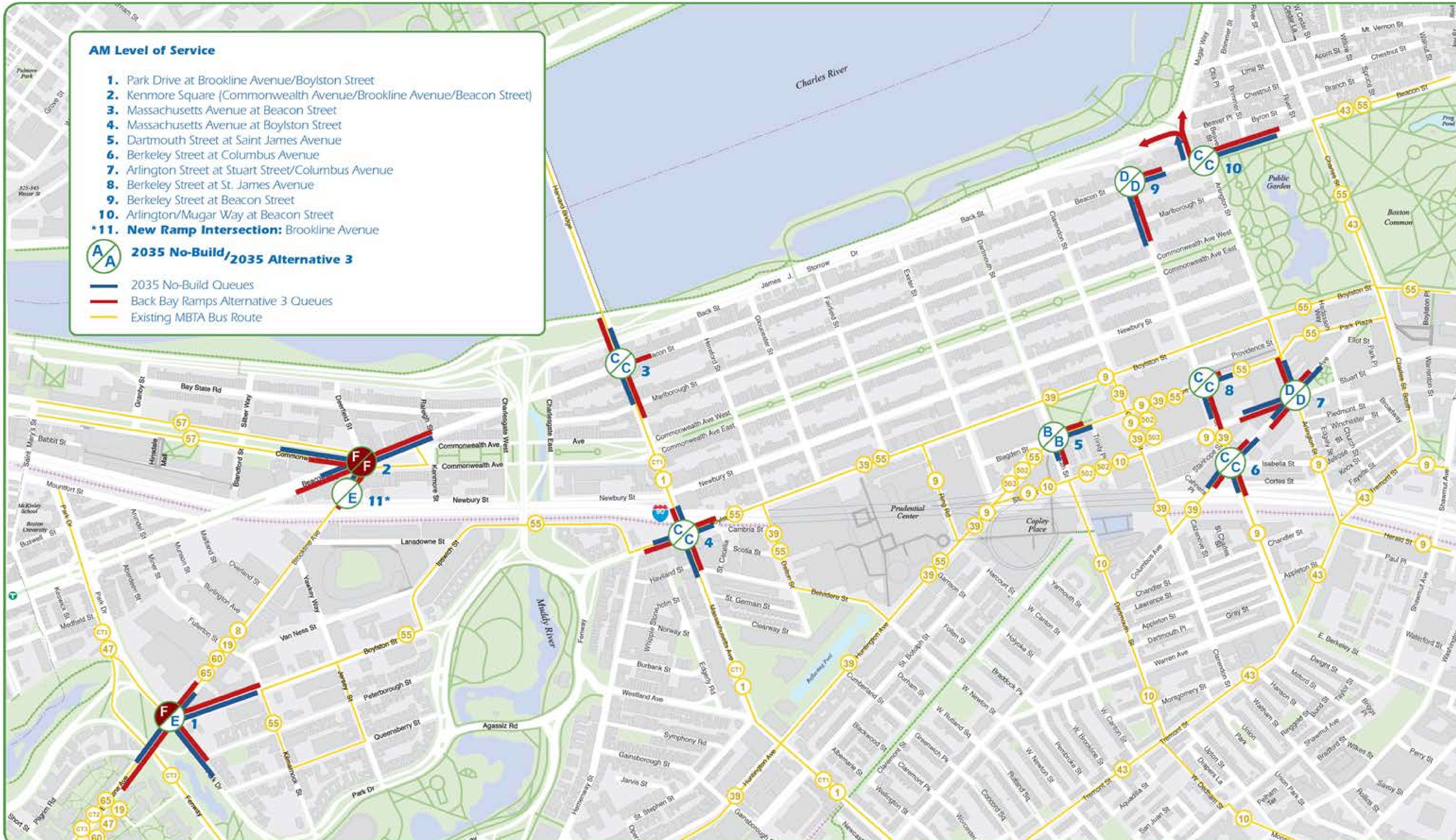



**FIGURE 6-5**
**Back Bay Ramps Alternative 3**
**New Westbound Off-Ramp to Brookline Avenue: AM LOS**

massDOT
Massachusetts Department of Transportation

Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

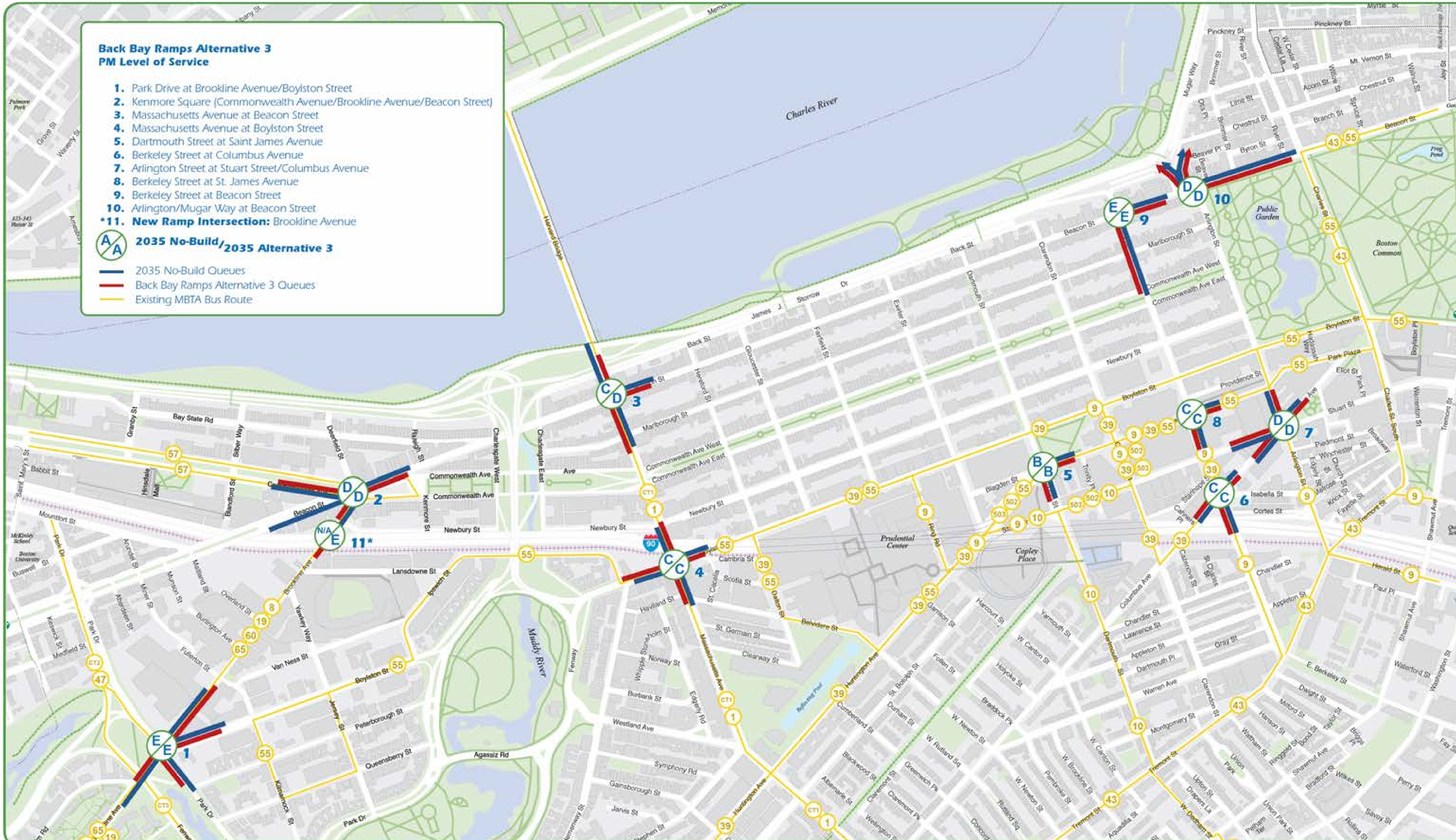



**FIGURE 6-6**
**Back Bay Ramps Alternative 3**
**New Westbound Off-Ramp to Brookline Avenue: PM LOS**

massDOT
Massachusetts Department of Transportation
Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

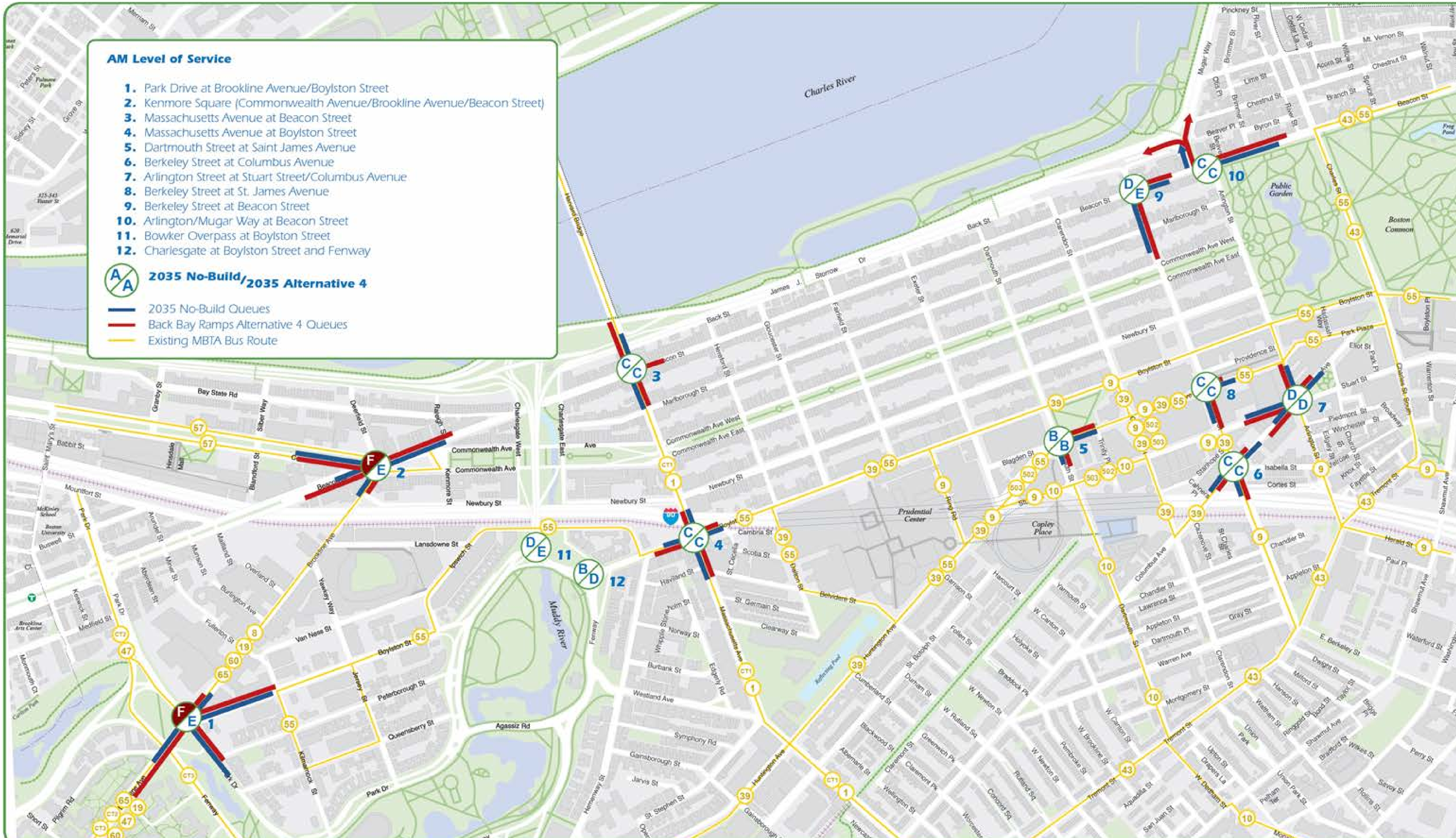



**FIGURE 6-7**
**Back Bay Ramps Alternative 4**
**New Eastbound On-Ramp from the Bowker Overpass: AM LOS**

massDOT
Massachusetts Department of Transportation
Massachusetts Turnpike Boston Ramps and Bowker Overpass Study

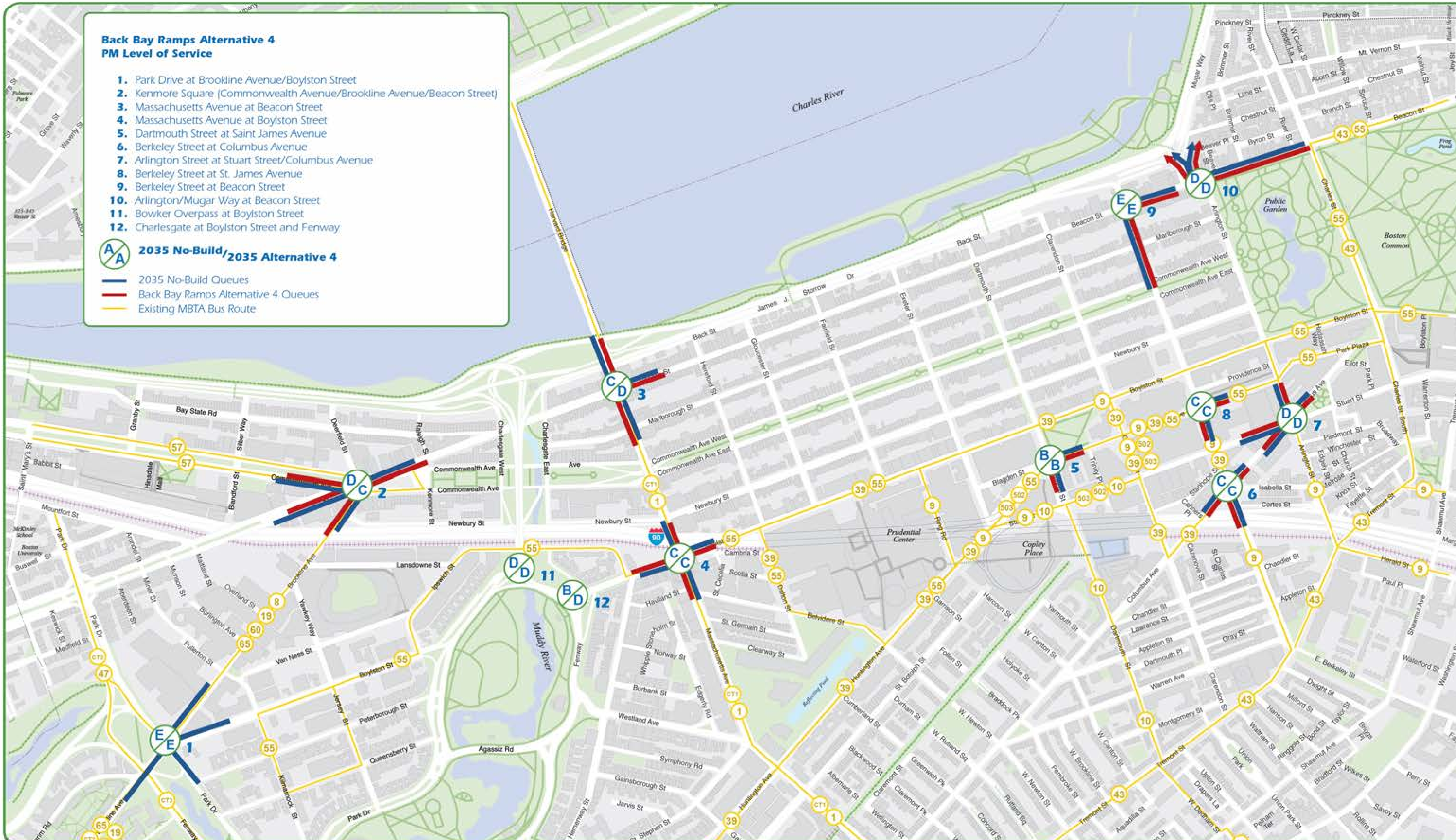



**FIGURE 6-8**
**Back Bay Ramps Alternative 4**
**New Eastbound On-Ramp from the Bowker Overpass: PM LOS**

## 6.6 BACK BAY RAMPS NOISE EVALUATION

This exercise provides a planning-level noise evaluation of the Back Bay Ramp Alternatives. The noise evaluation calculated the potential sound levels associated with the change in roadway alignments and vehicular traffic using the Federal Highway Administration's (FHWA) Traffic Noise Model (TNM) Version 2.5.1. An abbreviated approach was used in developing the terrain for the project area noise model.

The FHWA has established noise abatement criteria (NAC) to help protect the public from excessive traffic noise, which MassDOT has endorsed. Recognizing that different areas are sensitive to noise in different ways, the NAC varies according to land use. The NAC for residential land use is 67 dB(A). MassDOT endorses the FHWA's procedures and considers noise impacts to occur when existing or future sound levels approach (within 1 dB(A)) or exceeds the NAC, or when future sound levels exceed the existing sound levels by 10 dB(A) or more. For each of the alternatives, the TNM model was used to calculate the distance or noise contour line from the primary roadways to where the sound level of 66 dB(A) would occur. The number of impacted receptor locations was determined by counting the residential receptor locations that were within the 66 dB(A) noise contour line.

The FHWA's TNM model was used to calculate sound levels associated with each of the Back Bay Alternatives for the Existing and Build conditions. The results of the noise analysis demonstrated that there is no significant change in the sound levels between the Existing and Build conditions for most of the alternatives and the number of residential units impacted also did not change.

However, based upon this planning-level evaluation, the alternatives can be ranked based upon the total number of impacted residential receptor locations. Table 6-6 provides information about the number of residential units impacted. As shown in the table, the number of impacted residential units does not increase from the 2010 existing conditions to the 2035 build conditions. But based on a ranking system that examines the total number of impacted residential units by the alternatives, then Back Bay Alternative 2 is the highest ranked (least number of impacted residential units) and Back Bay Alternative 4 is the lowest ranked alternative (greatest number of impacted residential units) as summarized in Table 6-7.

**TABLE 6-6**
**Back Bay Alternative Impacts**

| | 2010 Existing Conditions | | 2035 Build Conditions | |
|---|---|---|---|---|
| | Impact Distance (FT) | Impacted Residential Units (#) | Impact Distance (Ft) | Impacted Residential Units (#) |
| Alternative 1 | | | | |
| Cortes Street | 75 | 116 | 75 | 116 |
| Fayette Street | 75 | 2 | 75 | 2 |
| Total | | 118 | | 118 |
| Alternative 2 | | | | |
| Cahners Place | 75 | 17 | 75 | 27 |
| Total | | 27 | | 27 |
| Alternative 3 | | | | |
| Newbury Street | 50 | 98 | 50 | 98 |
| Total | | 98 | | 98 |
| Alternative 4 | | | | |
| Newbury Street | 175 | 122 | 175 | 122 |
| Ipswich Street | 100 | 91 | 100 | 91 |
| Total | | 213 | | 213 |

**TABLE 6-7**
**Back Bay Alternative Rankings**

| | |
|---|---|
| 1. | Alternative #2 with 27 Residential Receptors impacted |
| 2. | Alternative #3 with 98 Residential Receptors impacted |
| 3. | Alternative #1 with 118 Residential Receptors impacted |
| 4. | Alternative #4 with 213 Residential Receptors impacted |

# Chapter 7—Future-Year Alternative Analysis: Bowker Overpass

## 7.1 INTRODUCTION

This chapter describes the analysis of the future-year transportation conditions for the Bowker Overpass during a typical workday, emphasizing the peak commuting hours. Staff used the Boston regional model to forecast AM and PM peak-hour volumes in 2035 for each of the four study alternatives. Staff then applied the volumes to I-90 and selected intersections to determine their performance under each scenario. Performance was measured in terms of speed, density (passenger cars/miles/lane), and level of service (LOS). Staff used two software tools to evaluate the alternatives' operations:

- Highway Capacity Software (HCS) 2010—a traffic-analysis software based on the Highway Capacity Manual—to evaluate performance
- Synchro—a traffic-capacity and simulation program developed and distributed by Trafficware Ltd.—to perform capacity analysis for an individual intersection or a series of intersections in a roadway network

Staff also conducted a noise analysis to evaluate the potential sound levels associated with changes in roadway alignments and vehicular traffic using the Federal Highway Administration's Traffic Noise Model Version 2.5. A memorandum detailing the noise analysis is provided in Appendix B of this report.

## 7.2 I-90 RAMP RESULTS

The merges and diverges that take place at on- and off-ramps also were analyzed, as shown in Table 7-1. There were no significant impacts in I-90 performance within Alternatives 3 and 4 in either the AM or PM peak hours. Operations are expected to perform at LOS C and D during both peak hours, for both alternatives.

## TABLE 7-1
## Level of Service I-90: Ramp Results for 2035 Alternatives 3 and 4

| Location | Merge or Diverge | Ramp Volume | Freeway Volume | Computed Speeds (MPH) | Density (Passenger Cars/ Mile/Lane) | LOS | Ramp Volume | Freeway Volume | Computed Speeds (MPH) | Density (Passenger Cars/ Mile/Lane) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AM PEAK PERIOD | | | | | | | | | | | |
| I-90 EB Bowker Off-ramp | Diverge | 595 | 8127 | 48.7 | 33.4 | D | 641 | 8160 | 48.7 | 33.8 | D |
| I-90 EB Bowker On-ramp | Merge | 494 | 8026 | 54.0 | 33.1 | D | 522 | 8042 | 54.0 | 33.4 | D |
| I-90 WB Bowker Off-ramp | Diverge | 707 | 5882 | 48.6 | 25.5 | C | 811 | 5896 | 48.5 | 26.0 | C |
| I-90 WB Bowker On-ramp | Merge | 340 | 5174 | 57.0 | 23.0 | C | 386 | 5084 | 57.0 | 23.1 | C |
| PM PEAK PERIOD | | | | | | | | | | | |
| I-90 EB Bowker Off-ramp | Diverge | 430 | 6718 | 48.9 | 27.3 | C | 501 | 6792 | 48.8 | 27.9 | C |
| I-90 EB Bowker On-ramp | Merge | 490 | 6777 | 56.0 | 29.2 | D | 546 | 6836 | 57.0 | 20.0 | B |
| I-90 WB Bowker Off-ramp | Diverge | 637 | 5987 | 48.7 | 25.5 | C | 677 | 6050 | 48.6 | 25.9 | C |
| I-90 WB Bowker On-ramp | Merge | 587 | 5356 | 57.0 | 25.4 | C | 622 | 5378 | 56.0 | 25.7 | C |

## 7.3 BOWKER OVERPASS: INTERSECTION RESULTS

Staff used Synchro to analyze selected intersections for the Bowker Overpass alternatives for the AM and PM peak hours in the Boston area. The selected intersections cited below were determined to be key intersections for evaluating traffic operations for the alternatives.

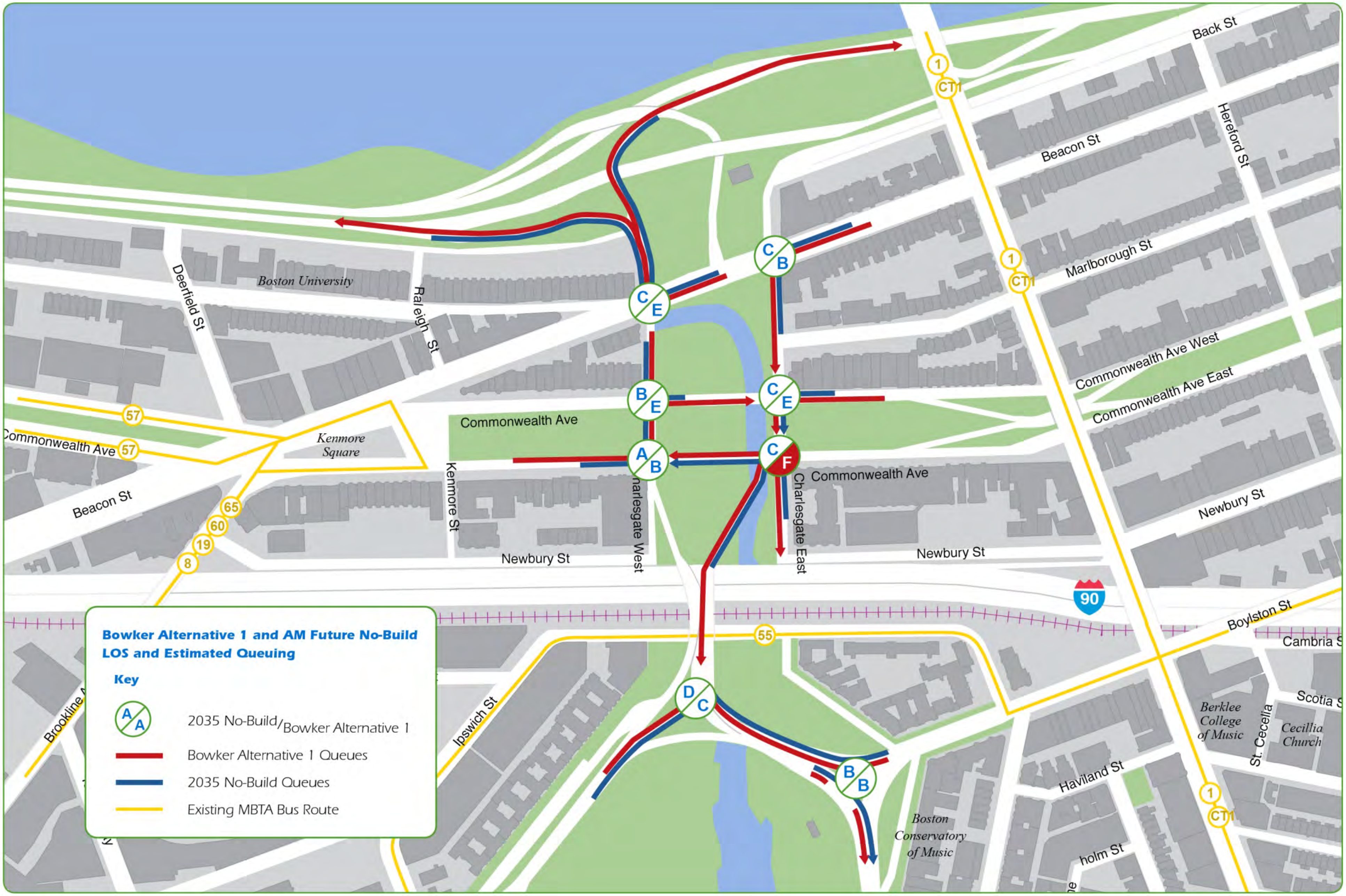
- Beacon Street at Charlesgate East
- Beacon Street at Charlesgate West
- Commonwealth Avenue East at Charlesgate East
- Commonwealth Avenue East at Charlesgate West
- Commonwealth Avenue West at Charlesgate East
- Commonwealth Avenue West at Charlesgate West
- Bowker Overpass at Boylston Street
- Charlesgate at Bolyston Street and Fenway

Staff analyzed the following additional intersections based on the Bowker Overpass alternative:

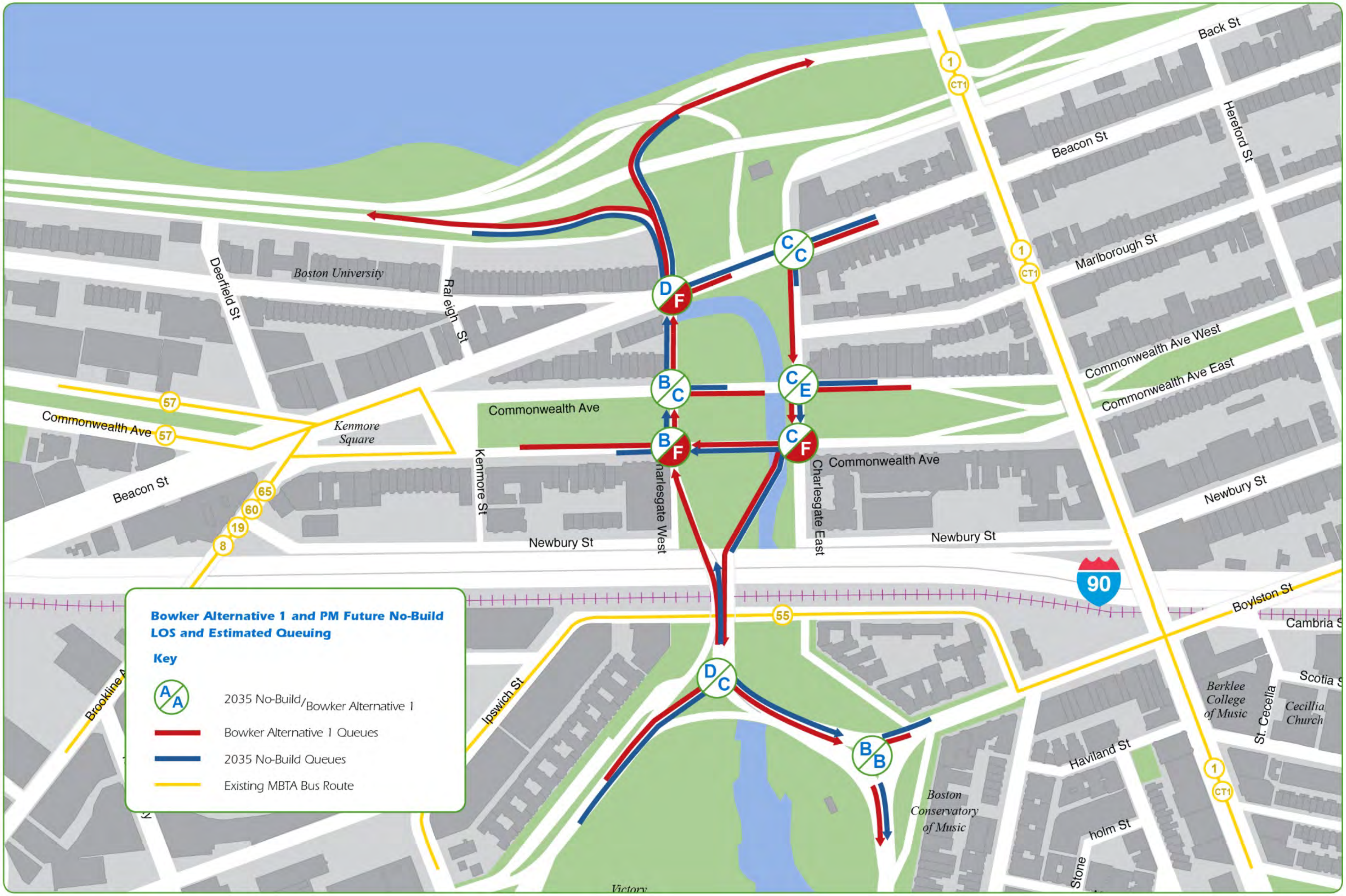
- New Ramp intersection: Bowker Overpass at Massachusetts Turnpike Eastbound Ramps
- New Ramp intersection: Bowker Overpass at Massachusetts Turnpike Westbound Ramps
- New Ramp intersection: Storrow Drive Eastbound at Massachusetts Avenue
- New Ramp intersection: Storrow Drive Westbound at Massachusetts Avenue

Figures 7-1 through 7-8 present the LOS and queuing results for the AM and PM peak hours at the key intersections. The LOS and queuing results for Alternative 1 show that removing the Bowker Overpass would result in a decrease in LOS operations with several intersections having a LOS of F. Significant increases in potential queuing occur, with expected queues spilling back through previous intersections.

The expected operations for Alternative 2, with a new at-grade roadway, indicate that four intersections would be LOS F in the AM peak hour. There is also the potential for gridlock because of the expected queues. Alternative 3, with the new Massachusetts Turnpike interchange, will operate at acceptable LOS, except at the Beacon Street at Charlesgate West intersection. With the overpass removed, Beacon Street and Kenmore Square are expected to see significant increases in traffic volumes. As with Alternative 3, Alternative 4 also would see acceptable LOS in the study area, with one exception. The new interchange intersections with Storrow Drive and Massachusetts Avenue are expected to have an LOS of F. These intersections would provide Storrow Drive access to the Fenway and Longwood Medical areas; which previously was accessed by the Storrow Drive ramps to Beacon Street.




# FIGURE 7-1
## Bowker Alternative 1: AM
## Bowker Overpass Removed




# FIGURE 7-2
## Bowker Alternative 1: PM
## Bowker Overpass Removed

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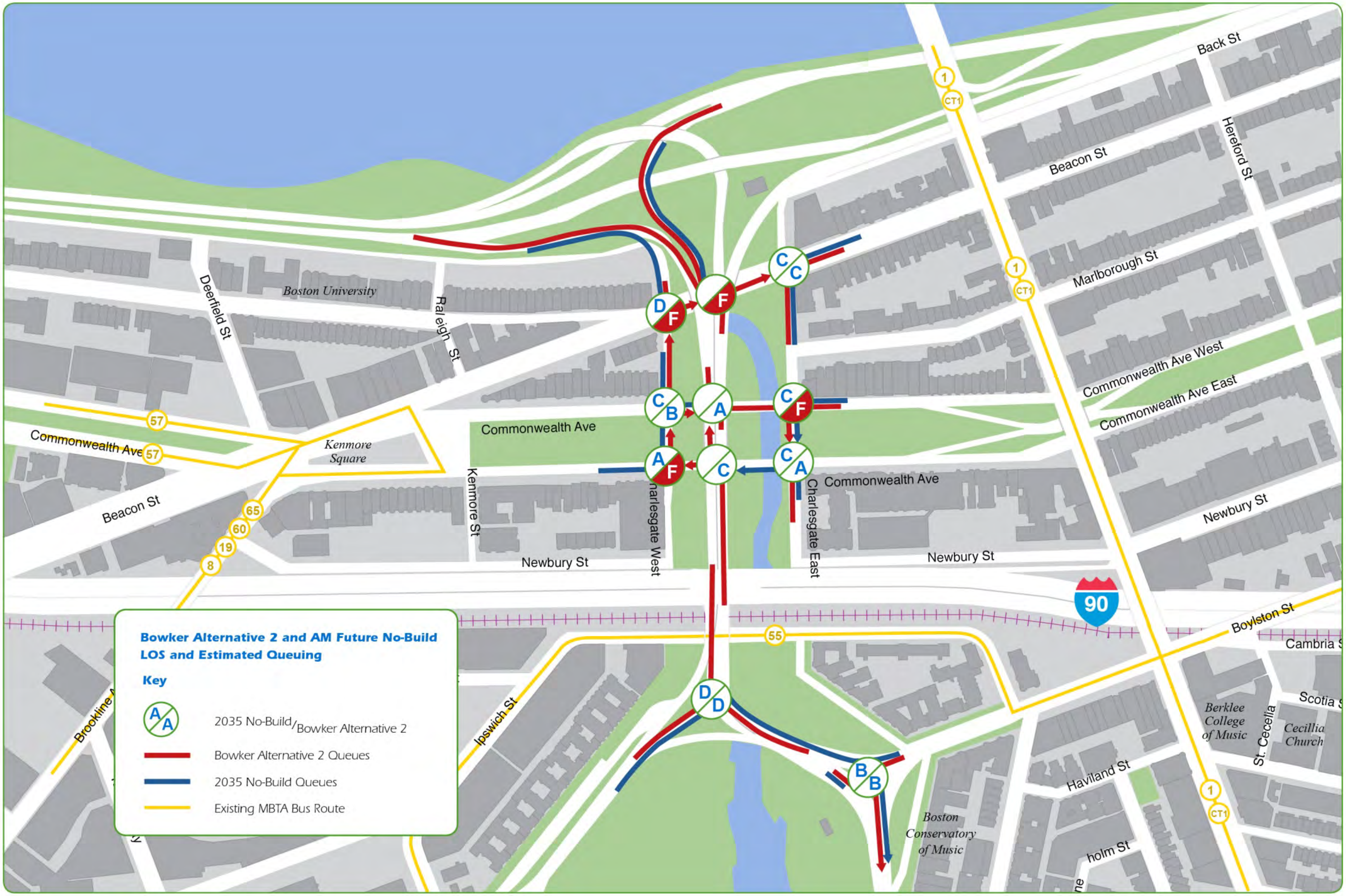
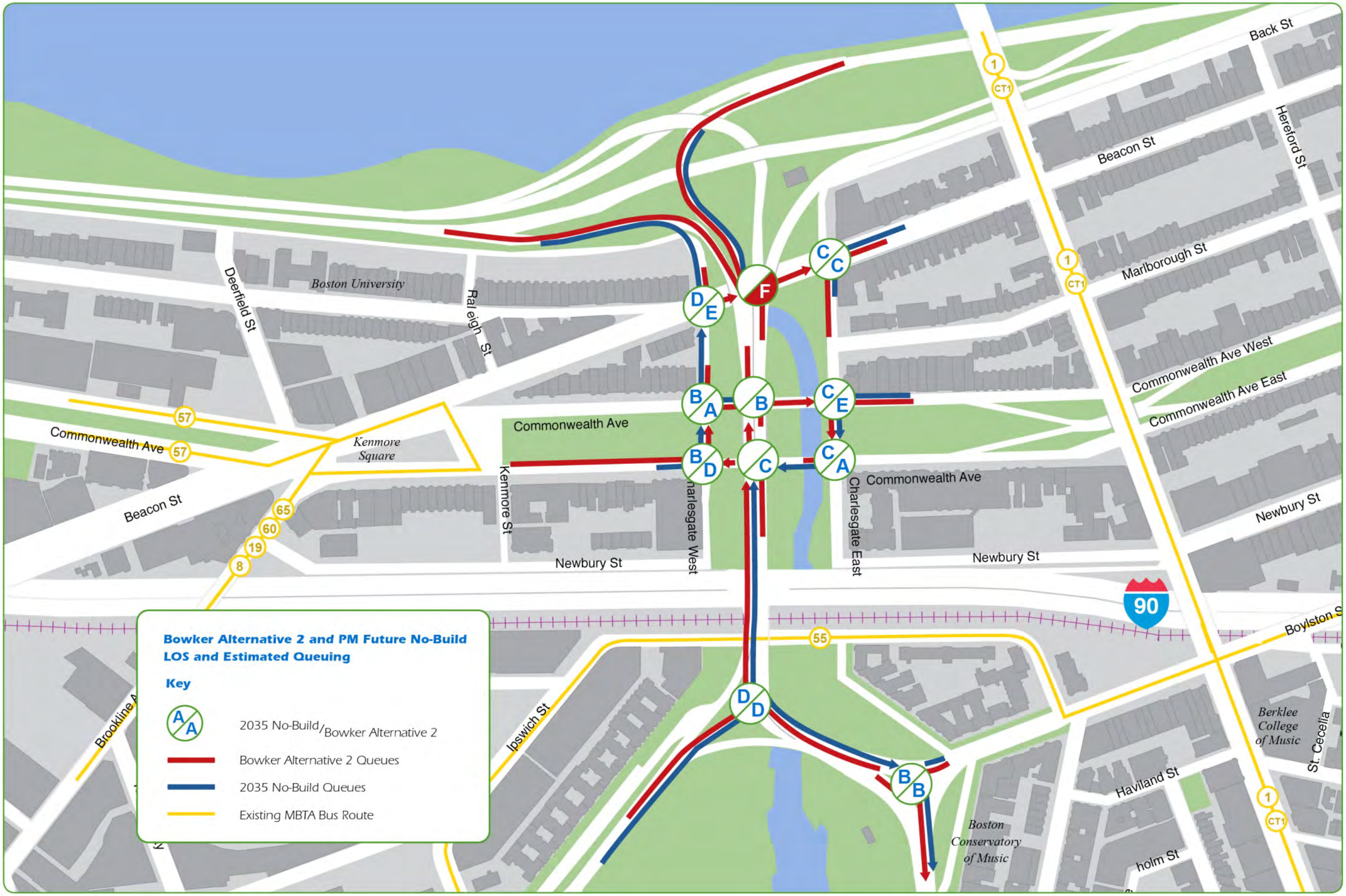



# FIGURE 7-3
## Bowker Alternative 2: AM
## Bowker Overpass At-grade




# FIGURE 7-4
## Bowker Alternative 2: PM
## Bowker Overpass At-grade

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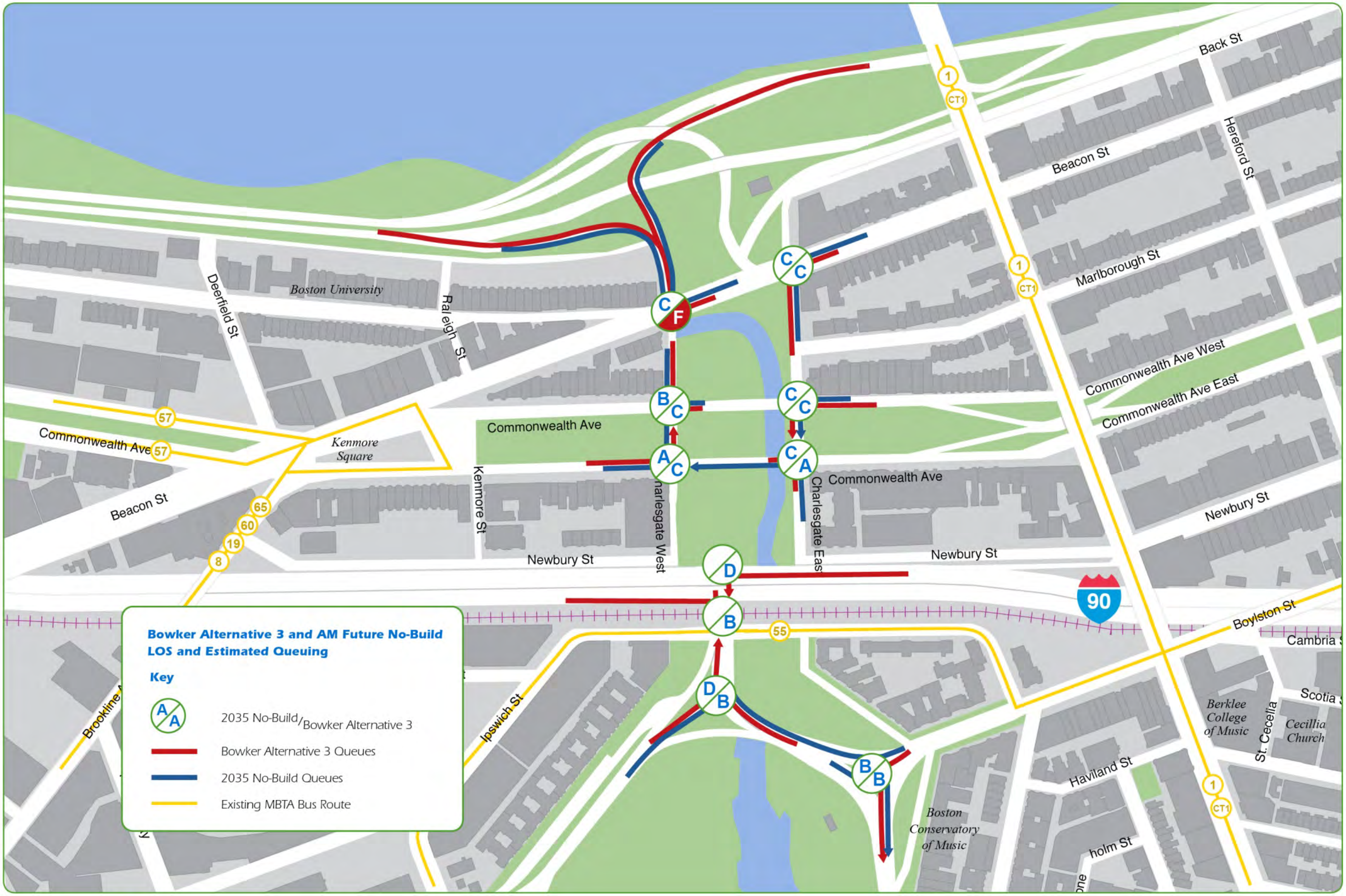


# FIGURE 7-5
## Bowker Alternative 3: AM
## New Regional Access

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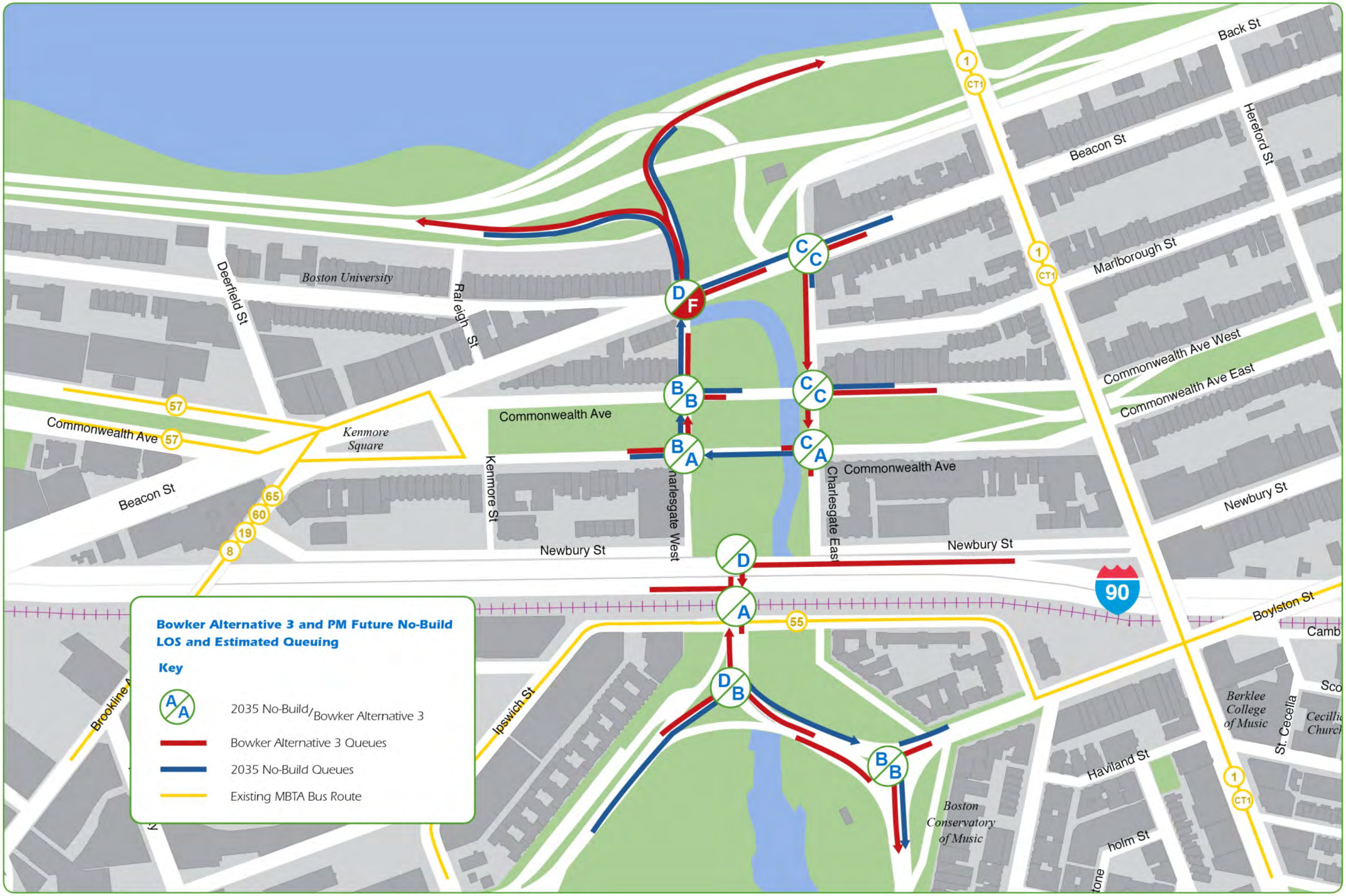


# FIGURE 7-6
## Bowker Alternative 3: PM
## New Regional Access

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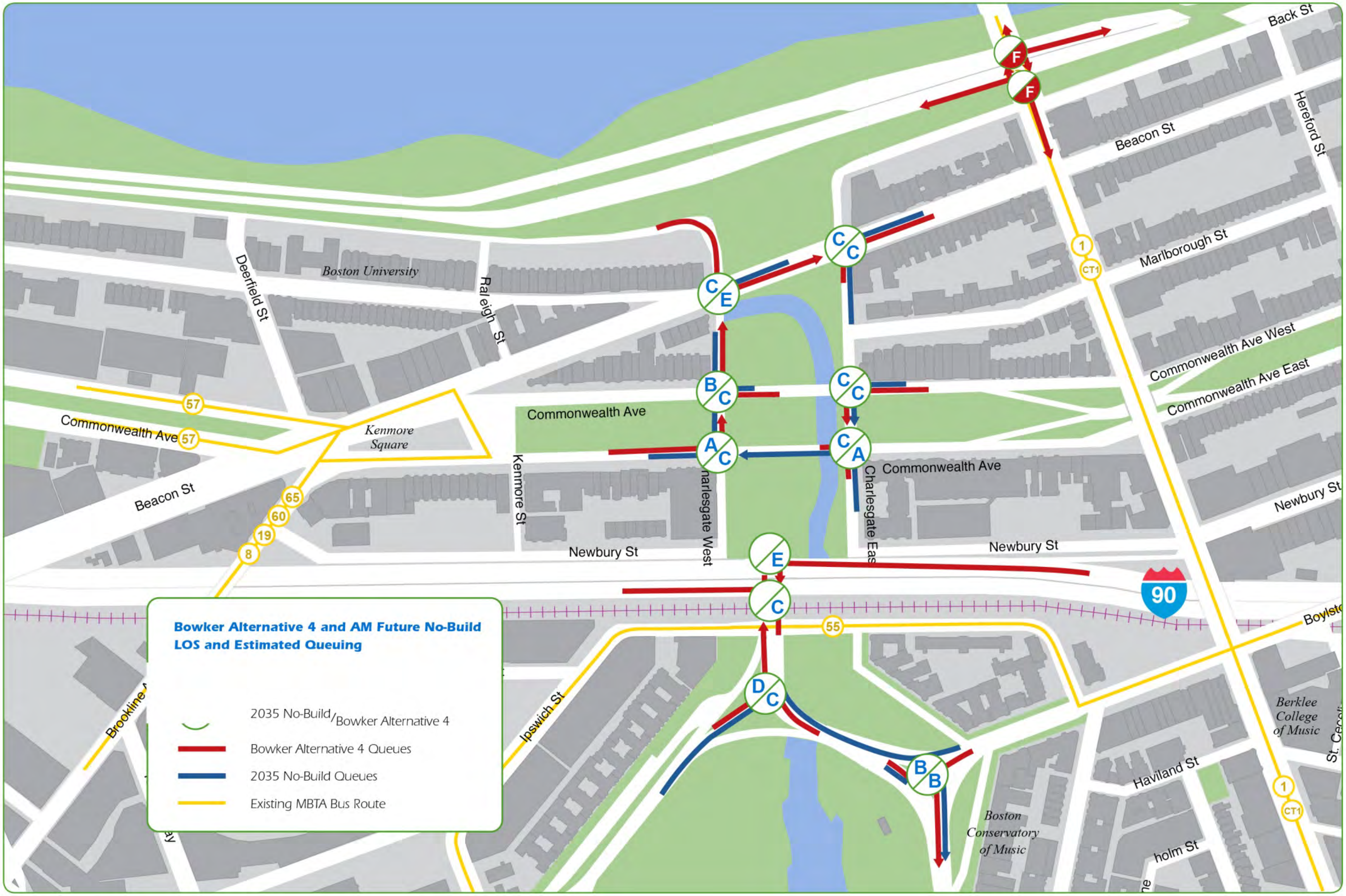


# FIGURE 7-7
# Bowker Alternative 4: AM
# New Regional and Local Access

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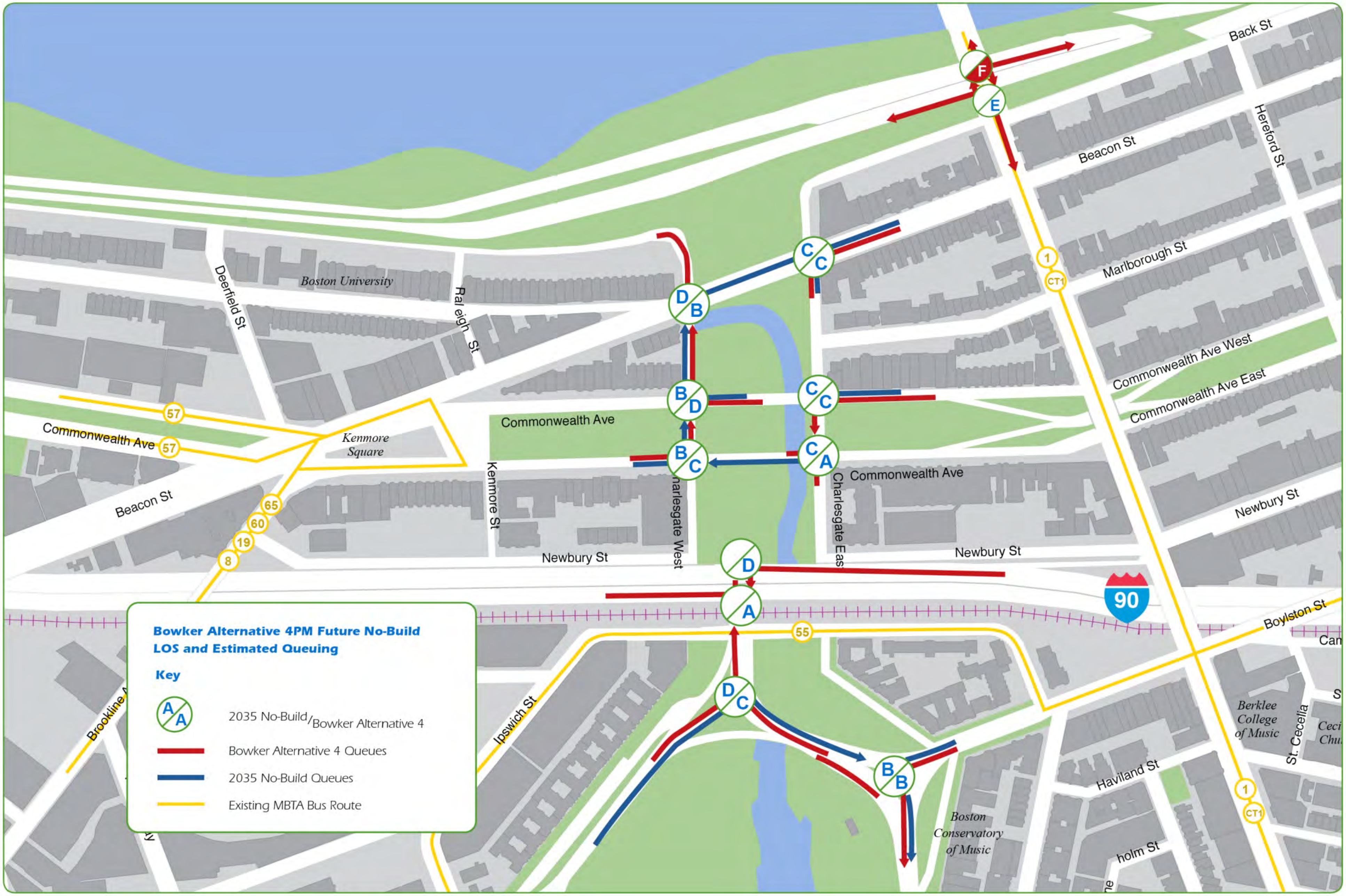


# FIGURE 7-8
# Bowker Alternative 4: PM
# New Regional and Local Access

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## 7.4 BOWKER OVERPASS: NOISE EVALUATION

As with the Back Bay Ramps, staff conducted a noise evaluation for the Bowker Overpass alternatives using the same methods and procedures described in Chapter 6. The results of the analysis—which used the FHWA's Traffic Noise Model (TNM) model to calculate sound levels associated with each of the Bowker Overpass alternatives for the Existing and Build conditions—demonstrated no significant change in the sound levels between the Existing and Build conditions for most of the alternatives.

However, based on this planning-level evaluation, the alternatives can be ranked by the total number of impacted residential receptor locations. As table 7-2 shows, alternatives 2 and 4 impact fewer residential units than the No-Build condition. For Alternative 2, there are 183 less residential units impacted, and for Alternative 4 there are 357 fewer units impacted. Alternatives 1 and 2 show that the same number of units are impacted for both conditions. The ranking is shown in Table 7-3.

**TABLE 7-2**
**Bowker Overpass Alternative Impacts**

| | 2010 Existing Conditions | | 2035 Build Conditions | |
|---|---|---|---|---|
| | Impact Distance (Ft) | Impacted Residential Units (#) | Impact Distance (Ft) | Impacted Residential Units (#) |
| Alternative 1 | | | | |
| Charlesgate East | 25 | 183 | 25 | 183 |
| Charlesgate West | 25 | 174 | 25 | 174 |
| Total | | 357 | | 357 |
| Alternative 2 | | | | |
| Charlesgate East | 25 | 183 | 15 | 0 |
| Charlesgate West | 25 | 174 | 25 | 174 |
| Total | | 357 | | 174 |
| Alternative 3 | | | | |
| Charlesgate East | 25 | 183 | 25 | 183 |
| Charlesgate West | 25 | 174 | 25 | 174 |
| Newbury Street | 175 | 122 | 25 | 122 |
| Ipswich Street | 100 | 91 | 125 | 91 |
| Total | | 570 | | 570 |
| Alternative 4 | | | | |
| Charlesgate East | 25 | 183 | 0 | 0 |
| Charlesgate West | 25 | 174 | 0 | 0 |
| Newbury Street | 175 | 122 | 25 | 122 |
| Ipswich Street | 100 | 91 | 125 | 91 |
| Total | | 270 | | 213 |

**TABLE 7-3**
**Bowker Overpass Alternative Rankings**

| | |
|---|---|
| 1. | Alternative #2 with 174 Residential Receptors impacted |
| 2. | Alternative #4 with 213 Residential Receptors impacted |
| 3. | Alternative #1 with 357 Residential Receptors impacted |
| 4. | Alternative #3 with 570 Residential Receptors impacted |

## 7.5 BOWKER OVERPASS: BICYCLE AND PEDESTRIAN LOS

As with vehicle LOS, there are measures to estimate bikeability and walkability. Several methods have been proposed, but for this study staff chose a calculator developed by the League of Illinois Bicyclists (http://www.bikelib.org/roads/blos/losform.htm). This particular calculator is nationally recognized and takes into account traffic volumes, which can be major stressors for bicyclists and pedestrians. Like vehicle LOS, the calculator assigns a letter grade of A through F, with A reflecting best conditions and F reflecting worst. The bicycle LOS and pedestrian LOS utilize the following inputs:

- Number of through lanes per direction
- Width of outside/right-most lane
- Width of paved shoulder, bike lane, or on-street parking lane
- Average Daily Traffic (ADT)
- Posted speed limit
- Percentage of heavy vehicles
- Pavement condition rating
- Percentage of road segment with occupied on-street parking
- Percentage of segment with sidewalks
- Sidewalk width
- Sidewalk buffer width
- Average tree spacing within sidewalk buffer

Table 7-4 below suggests how bicycle and pedestrian LOS might change under the four Bowker Overpass alternatives. These estimates are based only on changes to vehicle traffic volumes, not design. For bicyclists, conditions would improve on the Bowker Overpass (only the segment over the Mass Pike) in all scenarios because the north-south vehicle traffic using the overpass decreases. Conditions would deteriorate somewhat for both bicyclists and pedestrians under both Alternatives 1 and 3 because of increased at-grade traffic along Charlesgate. Alternatives 2 and 4 show slight improvements in both bicycle and pedestrian LOS because of improved vehicle traffic flow.

**TABLE 7-4**
**Bicycle and Pedestrian LOS for Bowker Alternatives**

| | Direction | Existing Conditions | 2035 Alt 1 | 2035 Alt 2 | 2035 Alt 3 | 2035 Alt 4 |
|---|---|---|---|---|---|---|
| **BICYCLE LOS** | | | | | | |
| Commonwealth Avenue | EB | D | D | D | D | D |
| | WB | D | D | D | D | D |
| Charlesgate | NB | D | E | D | E | D |
| | SB | D | E | D | D | C |
| Beacon Street | WB | B | B | B | B | B |
| Bowker Overpass over Mass Turnpike | NB | F | C | C | C | C |
| | SB | F | C | C | C | C |
| **PEDESTRIAN LOS** | | | | | | |
| Commonwealth Avenue | EB | C | C | D | D | C |
| | WB | C | C | C | C | C |
| Charlesgate | NB | C | F | C | D | B |
| | SB | C | F | C | D | B |
| Beacon Street | WB | B | B | B | B | B |
| Bowker Overpass over Mass Turnpike | NB | C | C | C | C | C |
| | SB | C | C | C | C | C |

# Chapter 8—ENVIRONMENTAL JUSTICE ANALYSIS

## 8.1 BACKGROUND

This section provides an overview of the environmental justice (EJ) analysis for the Massachusetts Turnpike Boston Ramps and Bowker Overpass Study, including a brief description of the methodology used by the Central Transportation Planning Staff (CTPS) to analyze EJ effects. This chapter also summarizes the effects of each build alternative on the EJ population zones near the Massachusetts Turnpike. Staff performed statistical analysis to determine whether the impact on the EJ areas is statistically significant compared to the impact on the non-EJ areas in the required categories of accessibility, mobility, and air quality.

EJ is based on the principle that all people have a right to be protected from harmful environmental effects and to enjoy a clean, healthy environment. EJ concerns the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, policies, and equitable distribution of environmental benefits.

The Commonwealth of Massachusetts' Executive Office of Energy and Environmental Affairs (EEA) has established an EJ policy to help address the disproportionate share of environmental burdens experienced by lower-income populations and minority communities. The policy is designed to help ensure the protection of these groups from harmful environmental effects. It also aims to promote community involvement in planning and decision making to maintain and/or enhance the quality of affected neighborhoods in terms of the environment. The EJ policy directs state resources to serve (but not be limited to) minority and low-income populations and neighborhoods across the state. These resources will ensure that EJ populations have a strong voice in environmental decision making; receive the full protection afforded them through existing environmental rules and regulations; and increase access to investments that will enhance equality of life in low-income and minority communities by restoring degraded natural resources, enhancing open space, and building urban park networks.

The "EJ Assessment," is a detailed, system-level analysis conducted with the statewide transportation model. This assessment is based on the Boston Region Metropolitan Planning Organization's (MPO) assessment of projects contained in its Long-Range Transportation Plan (LRTP). It examines the distribution of benefits and burdens brought on by proposed transportation projects among EJ and non-EJ population

zones in the MPO region. Its purpose is to determine if there are disproportionate burdens on protected minority and low-income populations, respectively.

## 8.2 METHODOLOGY

### 8.2.1 EJ Area Definition

The Federal Transit Authority's (FTA) Title VI circular defines a predominantly minority area as a geographic area where the proportion of minority persons present exceeds the average proportion of minority persons in the recipient's service area. The geographic area referenced by the MPO and CTPS is a transportation analysis zone (TAZ)—an aggregate of census geography based on population and number of trips that is used to model transportation behavior. For Title VI purposes, when identifying benefits and burdens of proposed transportation projects, the MPO has defined a minority TAZ as one whose minority population (nonwhite and Hispanic of all races) is greater than the overall MPO region's average minority population of 27.8%.

FTA's EJ circular and the Federal Highway Administration's (FHWA) EJ guidance define a low-income person as one whose median household income is at or below the Department of Health and Human Services' poverty guidelines. Metropolitan planning organizations also are allowed to use their own definitions or thresholds, or a percentage of median income for their regions, as long as their definitions meet or exceed the federal definition. The Boston Region MPO defines the low-income threshold for an individual as one living in a household whose median income is 60% or less than the median MPO household income. According to the 2006–2010 American Community Survey, the regional MPO household income is $70,829. Therefore, the MPO's low-income threshold is $42,497. (The poverty guideline for a family of four was $23,050 when this threshold was developed.) This income threshold is used for all of the MPO's EJ analyses conducted for the LRTP and the Transportation Improvement Plan (TIP).

The EJ study area is defined as one-half mile on either side of the Massachusetts Turnpike between Essex Street in Brookline to the west and Shawmut Avenue in Boston to the east. (Note: Cambridge TAZs on the north side of the Charles River are not included.) Only a fraction of some TAZs is included in the buffer area. TAZs that have less than 50% of their area in the buffer were not included unless the proportion of minority residents in the TAZ exceeds the regional average of 27.8% and/or average household income is less than or equal to 60% of the median household income ($42,497) for the region.

Figure 8-1 shows the 94 TAZs included in the study area and indicates those that are considered to be either minority, low-income, or both. Thirty-seven TAZs are neither

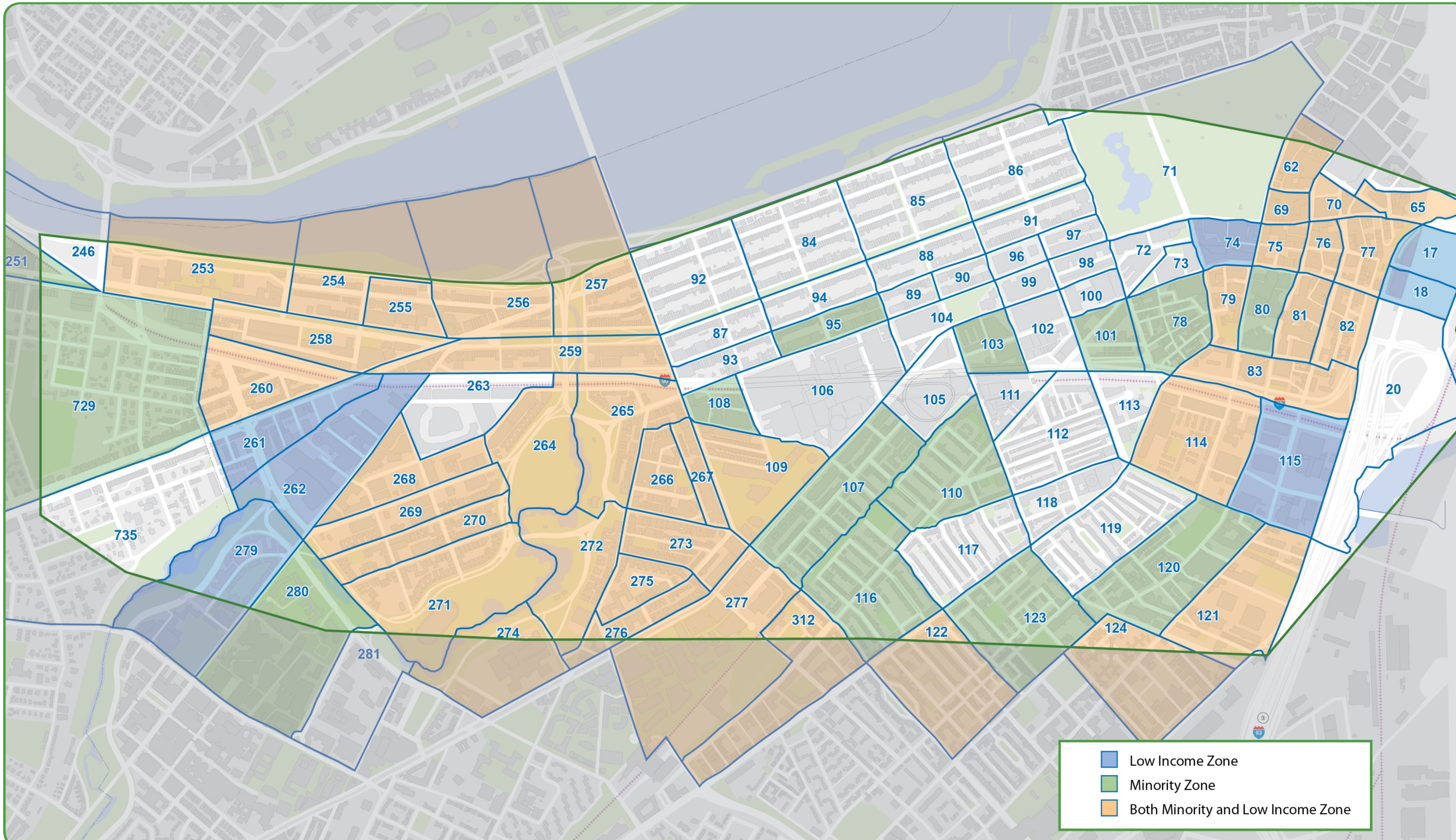


**FIGURE 8-1**
**Massachusetts Turnpike Boston Ramps and Bowker Overpass**
**Environmental Justice Study Area**

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low-income nor minority; five are low-income; 14 are minority; and 38 are both low-income and minority.

Note that all build alternatives were modeled using 2035 demographic projections. These assumed that the characteristics of the residential populations in the project area would remain the same as those observed in the 2010 US Census, and that the EJ population's growth rate would be the same as that forecasted by the Metropolitan Area Planning Council for the overall population of the region.

### 8.2.2 Performance Measures

Three categories of performance measures were used in the EJ analysis as indicators of benefits and burdens for EJ and non-EJ TAZs. One of the three performance measures was transit populations. However, this study's proposed changes apply to the roadway network, with no changes to the transit network. Therefore, the EJ analysis for the Massachusetts Turnpike Boston Ramps and Bowker Overpass study focuses on auto trips travelling to and from the study area TAZs. The three categories of performance measures for this study are:

- Accessibility to jobs and needed services
- Mobility and congestion
- Environmental impacts

Accessibility is determined both by the ability to reach desired destinations and the ease of doing so. An accessibility analysis for an EJ study looks at the number of basic, retail, and service employment opportunities, health-care facilities, and colleges that can be reached within 20 minutes by car; and examines the average travel time from EJ TAZs to these establishments.

The mobility and congestion analysis focuses on the average door-to-door travel time under congested conditions for auto trips travelling from and to EJ TAZs. The types of door-to-door travel times examined are:

- Highway production time—The average travel time of all auto trips departing from a TAZ
- Highway attraction time—The average travel time of all auto trips arriving at a TAZ

The environmental impact analysis focuses on the effect of roadway or transit projects on the regional and local air quality. The air-quality analysis for EJ studies examines the volume of carbon monoxide (CO) and fine particulate matter (PM2.5) emitted per square mile, and average vehicle-miles traveled under congested traffic conditions.

In order to evaluate the degree of benefits and burdens brought by roadway projects to the accessibility, mobility, and air quality for EJ and non-EJ neighborhoods, CTPS conducted t-test analyses to determine whether the differences were statistically significant. Two sample t-tests of each performance measure were conducted between a sample of EJ and non-EJ TAZs in the study area. In statistical-significance testing, the p-value is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. If the null hypothesis is rejected, the result is considered statistically significant. In this study, the base hypothesis is that there is no significant difference in the benefits and burdens between EJ and non-EJ TAZs. The significance level is 0.05. If the p-value is greater than or equal to 0.05, the difference of benefits or burdens brought by a roadway alternative between EJ and non-EJ neighborhoods is statistically insignificant. If the p-value were less than 0.05, the benefits or burdens would be considered statistically significant.

EJ assessments were done for minority TAZs and low-income TAZs separately to satisfy both the FTA's Title VI and EJ circulars. FTA circulars were chosen—despite that the primary mode of the project related to vehicular travel—because of their more robust analytic techniques,  in CTPS's opinion. Using FTA circulars also allows for consistency across all such analyses performed by the agency.

Build alternatives are listed in Table 8-1 below.

**TABLE 8-1**
**Build Alternatives**

| Bowker Overpass Alternatives |
|---|
| 1. Bowker overpass removed |
| 2. Bowker overpass at grade |
| 3. New regional access |
| 4. New regional and local access |
| **Back Bay Alternatives** |
| 1. New westbound off-ramp to Berkeley Street |
| 2. New westbound off-ramp to Trinity Place/Stuart Street |
| 3. New westbound off-ramp to Brookline Avenue |
| 4. New eastbound on-ramp from the Bowker Overpass |

## 8.3 SUMMARY OF RESULTS

The study area, defined to include TAZs within one-half mile of the Massachusetts Turnpike, encompasses 94 TAZs. Of the total number of TAZs, 37 are neither low-income nor minority; 5 are low-income; 14 are minority; and 38 are both low-income and minority.

The differences were calculated between the eight build- and no-build alternatives for each TAZ. In the accessibility and mobility analyses, the benefits and burdens were averaged by the number of residents in each zone. In the air-quality analysis, they were weighted by the size of the zone. All results were aggregated to the study area for EJ and non-EJ TAZs, respectively. Results focus on six-hour peak periods only. Minority and low-income TAZs were analyzed separately to comply with both Title VI and EJ requirements.

### 8.3.1 Accessibility Analysis

Results from the accessibility analysis are summarized in Tables 8-2 through 8-5. Table 8-2 compares the number of jobs and services available within 20 minutes by car for minority and non-minority TAZs in the no-build alternative with those in each build alternative. It also summarizes the average travel time from minority and non-minority TAZs to reach these jobs and services. Table 8-3 compares access to medical facilities and higher education institutions. Tables 8-4 and 8-5 provide the same type of information for low-income and non-low-income TAZs.

In general, access to employment decreases slightly for minority TAZs and increases slightly for non-minority TAZs. Average roadway times remain essentially unchanged between no-build and build alternatives. Of note is access to employment under Bowker Alternative 4: New Regional and Local Access, where the number of jobs within a 20-minute drive of minority TAZs decreases more than under any other build alternative. Access to service jobs also decreases for non-minority TAZs under this alternative. While there are statistically significant differences in several build alternatives, they likely would fall within the model's margin of error, as the changes from the no-build alternative are less than 2.5% for both minority and non-minority TAZs. The differences in access to medical facilities and colleges and the average amount of time it takes to access these facilities from minority TAZs are negligible.

Access to employment for low-income TAZs remains relatively unchanged in the build alternatives. Of note is Bowker Alternative 4: New Regional and Local Access, where access to basic employment increases by 6% and access to retail and service employment decreases slightly. While there are statistically significant differences in several alternatives, there likely would not be disproportionate differences.

Average travel times to employment for low-income TAZs remain basically the same. Of note is Bowker Alternative 4: New Regional and Local Access, where average travel times decrease by 5%.

Access to medical facilities and higher education remains relatively the same for low-income TAZs. Of note is Bowker Alternative 4: New Regional and Local Access, where access to available hospital beds decreases by 5%. Again, while there are

## TABLE 8-2
## Employment Accessibility Summary, Minority and Non-Minority TAZs: No-build and Build Alternatives

| Location | Basic Employment | | | | Retail Employment | | | | Service Employment | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Available Basic Jobs/Service by Auto | | Average Roadway Time (Minutes) | | Number of Available Retail Jobs/Service by Auto | | Average Roadway Time (Minutes) | | Number of Available Service Jobs/Service by Auto | | Average Roadway Time (Minutes) | |
| | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority |
| No-build | 97,097 | 102,695 | 12.7 | 12.5 | 96,037 | 98,024 | 11.5 | 11.2 | 639,423 | 648,789 | 10.9 | 10.4 |
| Bowker Overpass Alternatives | | | | | | | | | | | | |
| Alternative 1: Bowker overpass removed | 96,809 | 102,786 | 12.8 | 12.5 | 95,812 | 98,020 | 11.6 | 11.2 | 637,844 | 649,838 | 10.9 | 10.4 |
| Alternative 2: Bowker overpass at-grade | 96,780 | 102,681 | 12.8 | 12.5 | 95,831 | 97,928 | 11.6 | 11.2 | 637,635 | 648,481 | 10.9 | 10.4 |
| Alternative 3: New regional access | 96,242 | 103,050 | 12.7 | 12.5 | 95,412 | 98,029 | 11.6 | 11.2 | 636,070 | 649,406 | 11.0 | 10.4 |
| Alternative 4: New regional and local access | 94,787 | 102,372 | 12.8 | 12.6 | 94,529 | 97,541 | 11.7 | 11.3 | 631,284 | 645,152 | 11.0 | 10.5 |
| Back Bay Alternatives | | | | | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 96,977 | 104,003 | 12.8 | 12.6 | 95,995 | 98,261 | 11.6 | 11.2 | 638,716 | 650,721 | 11.0 | 10.5 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 97,037 | 103,995 | 12.8 | 12.6 | 95,974 | 98,274 | 11.6 | 11.2 | 638,948 | 650,750 | 10.9 | 10.5 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 97,166 | 102,971 | 12.7 | 12.5 | 96,073 | 98,104 | 11.5 | 11.2 | 639,382 | 649,987 | 10.9 | 10.4 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 97,350 | 103,105 | 12.7 | 12.5 | 96,172 | 98,163 | 11.5 | 11.2 | 639,985 | 649,261 | 10.9 | 10.4 |
| Changes Between No-build and Build Alternatives | | | | | | | | | | | | |
| Bowker Overpass Alternatives | | | | | | | | | | | | |
| Alternative 1: Bowker overpass removed | -0.3% | 0.1% | 0.8% | 0.0% | -0.2% | 0.0% | 0.9% | 0.0% | -0.2% | 0.2% | 0.0% | 0.0% |
| Alternative 2: Bowker overpass at-grade | -0.3% | 0.0% | 0.8% | 0.0% | -0.2% | -0.1% | 0.9% | 0.0% | -0.3% | 0.0% | 0.0% | 0.0% |
| Alternative 3: New regional access | -0.9% | 0.3% | 0.0% | 0.0% | -0.7% | 0.0% | 0.9% | 0.0% | -0.5% | 0.1% | 0.9% | 0.0% |
| Alternative 4: New regional and local access | -2.4% | -0.3% | 0.8% | 0.8% | -1.6% | -0.5% | 1.7% | 0.9% | -1.3% | -0.6% | 0.9% | 1.0% |
| Back Bay Alternatives | | | | | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | -0.1% | 1.3% | 0.8% | 0.8% | 0.0% | 0.2% | 0.9% | 0.0% | -0.1% | 0.3% | 0.9% | 1.0% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | -0.1% | 1.3% | 0.8% | 0.8% | -0.1% | 0.3% | 0.9% | 0.0% | -0.1% | 0.3% | 0.0% | 1.0% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 0.1% | 0.3% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 0.3% | 0.4% | 0.0% | 0.0% | 0.1% | 0.1% | 0.0% | 0.0% | 0.1% | 0.1% | 0.0% | 0.0% |

**TABLE 8-3**
**Colleges and Hospital Bed Accessibility Summary, Minority and Non-Minority TAZs: No-build and Build Alternatives**

| Location | Access to Medical Facilities | | | | Access to High Education | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of Available Hospital Beds by Auto | | Average Roadway Time (Minutes) | | Number of Available College Enrollment by Auto | | Average Roadway Time (Minutes) | |
| | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority |
| No-build | 8,498 | 9,022 | 11.3 | 11.5 | 102,250 | 103,952 | 9.5 | 9.3 |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | 8,489 | 9,020 | 11.3 | 11.6 | 101,931 | 103,952 | 9.5 | 9.4 |
| Alternative 2: Bowker overpass at-grade | 8,486 | 9,010 | 11.3 | 11.6 | 101,990 | 103,952 | 9.5 | 9.4 |
| Alternative 3: New regional access | 8,404 | 8,994 | 11.3 | 11.6 | 102,261 | 104,006 | 9.7 | 9.4 |
| Alternative 4: New regional and local access | 8,176 | 8,886 | 11.2 | 11.5 | 101,299 | 103,379 | 9.6 | 9.4 |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 8,501 | 9,019 | 11.3 | 11.6 | 101,691 | 103,952 | 9.4 | 9.4 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 8,497 | 9,045 | 11.3 | 11.6 | 101,728 | 103,950 | 9.4 | 9.4 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 8,504 | 9,032 | 11.3 | 11.6 | 102,524 | 103,948 | 9.5 | 9.4 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 8,514 | 9,033 | 11.3 | 11.5 | 102,279 | 103,987 | 9.5 | 9.4 |
| **Changes Between No-build and Build Alternatives** | | | | | | | | |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | -0.1% | 0.0% | 0.0% | 0.9% | -0.3% | 0.0% | 0.0% | 1.1% |
| Alternative 2: Bowker overpass at-grade | -0.1% | -0.1% | 0.0% | 0.9% | -0.3% | 0.0% | 0.0% | 1.1% |
| Alternative 3: New regional access | -1.1% | -0.3% | 0.0% | 0.9% | 0.0% | 0.1% | 2.1% | 1.1% |
| Alternative 4: New regional and local access | -3.8% | -1.5% | -0.9% | 0.0% | -0.9% | -0.6% | 1.1% | 1.1% |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 0.0% | 0.0% | 0.0% | 0.9% | -0.5% | 0.0% | -1.1% | 1.1% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 0.0% | 0.3% | 0.0% | 0.9% | -0.5% | 0.0% | -1.1% | 1.1% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 0.1% | 0.1% | 0.0% | 0.9% | 0.3% | 0.0% | 0.0% | 1.1% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 1.1% |

**TABLE 8-4**
**Employment Accessibility Summary, Low-Income and Non-Low-Income TAZs: No-build and Build Alternatives**

| Location | Basic Employment | | | | Retail Employment | | | | Service Employment | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Available Basic Jobs/Service by Auto | | Average Roadway Time (Minutes) | | Number of Available Retail Jobs/Service by Auto | | Average Roadway Time (Minutes) | | Number of Available Service Jobs/Service by Auto | | Average Roadway Time (Minutes) | |
| | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority |
| No-build | 97,456 | 100,242 | 12.76 | 12.58 | 96,147 | 97,178 | 11.50 | 11.36 | 639,515 | 645,379 | 10.87 | 10.68 |
| **Bowker Overpass Alternatives** | | | | | | | | | | | | |
| Alternative 1: Bowker overpass removed | 97,222 | 100,127 | 12.78 | 12.58 | 95,948 | 97,060 | 11.52 | 11.37 | 637,998 | 645,424 | 10.87 | 10.69 |
| Alternative 2: Bowker overpass at-grade | 97,187 | 100,056 | 12.79 | 12.58 | 95,945 | 97,037 | 11.54 | 11.37 | 637,647 | 644,663 | 10.88 | 10.68 |
| Alternative 3: New regional access | 96,624 | 100,141 | 12.73 | 12.58 | 95,439 | 97,076 | 11.55 | 11.39 | 635,810 | 645,087 | 10.89 | 10.70 |
| Alternative 4: New regional and local access | 103,541 | 101,778 | 12.07 | 12.18 | 94,550 | 96,960 | 11.40 | 11.15 | 640,506 | 642,849 | 10.29 | 10.20 |
| **Back Bay Alternatives** | | | | | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 97,433 | 100,917 | 12.79 | 12.65 | 96,139 | 97,270 | 11.53 | 11.40 | 639,072 | 646,026 | 10.90 | 10.73 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 97,519 | 100,898 | 12.79 | 12.64 | 96,084 | 97,316 | 11.52 | 11.39 | 639,345 | 646,070 | 10.89 | 10.72 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 97,592 | 100,355 | 12.72 | 12.59 | 96,192 | 97,228 | 11.49 | 11.38 | 639,636 | 645,924 | 10.84 | 10.70 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 97,810 | 100,460 | 12.74 | 12.58 | 96,312 | 97,272 | 11.49 | 11.37 | 640,257 | 645,638 | 10.84 | 10.68 |
| **Changes Between No-build and Build Alternatives** | | | | | | | | | | | | |
| **Bowker Overpass Alternatives** | | | | | | | | | | | | |
| Alternative 1: Bowker overpass removed | -0.2% | -0.1% | 0.2% | 0.0% | -0.2% | -0.1% | 0.2% | 0.1% | -0.2% | 0.0% | 0.0% | 0.1% |
| Alternative 2: Bowker overpass at-grade | -0.3% | -0.2% | 0.2% | 0.0% | -0.2% | -0.1% | 0.3% | 0.1% | -0.3% | -0.1% | 0.1% | 0.0% |
| Alternative 3: New regional access | -0.9% | -0.1% | -0.2% | 0.0% | -0.7% | -0.1% | 0.4% | 0.3% | -0.6% | 0.0% | 0.2% | 0.2% |
| Alternative 4: New regional and local access | 6.2% | 1.5% | -5.4% | -3.2% | -1.7% | -0.2% | -0.9% | -1.9% | 0.2% | -0.4% | -5.3% | -4.5% |
| **Back Bay Alternatives** | | | | | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 0.0% | 0.7% | 0.2% | 0.6% | 0.0% | 0.1% | 0.3% | 0.4% | -0.1% | 0.1% | 0.3% | 0.5% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 0.1% | 0.7% | 0.2% | 0.5% | -0.1% | 0.1% | 0.2% | 0.3% | 0.0% | 0.1% | 0.2% | 0.4% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 0.1% | 0.1% | -0.3% | 0.1% | 0.0% | 0.1% | -0.1% | 0.2% | 0.0% | 0.1% | -0.3% | 0.2% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 0.4% | 0.2% | -0.2% | 0.0% | 0.2% | 0.1% | -0.1% | 0.1% | 0.1% | 0.0% | -0.3% | 0.0% |

**TABLE 8-5**
**Colleges and Hospital Bed Accessibility Summary, Low-Income and Non-Low-Income TAZs: No-build and Build Alternatives**

| Location | Access to Medical Facilities: Number of Available Hospital Beds by Auto – Minority | Access to Medical Facilities: Number of Available Hospital Beds by Auto – Non-Minority | Access to Medical Facilities: Average Roadway Time (Minutes) – Minority | Access to Medical Facilities: Average Roadway Time (Minutes) – Non-Minority | Access to High Education: Number of Available College Enrollment by Auto – Minority | Access to High Education: Number of Available College Enrollment by Auto – Non-Minority | Access to High Education: Average Roadway Time (Minutes) – Minority | Access to High Education: Average Roadway Time (Minutes) – Non-Minority |
|---|---|---|---|---|---|---|---|---|
| No-build | 8,513 | 8,818 | 11.28 | 11.55 | 101,682 | 104,132 | 9.38 | 9.53 |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | 8,503 | 8,815 | 11.28 | 11.56 | 101,281 | 104,132 | 9.37 | 9.56 |
| Alternative 2: Bowker overpass at-grade | 8,495 | 8,816 | 11.28 | 11.57 | 101,355 | 104,132 | 9.41 | 9.57 |
| Alternative 3: New regional access | 8,391 | 8,805 | 11.24 | 11.57 | 101,693 | 104,170 | 9.60 | 9.61 |
| Alternative 4: New regional and local access | 8,071 | 8,781 | 11.01 | 11.64 | 100,648 | 103,539 | 9.57 | 9.60 |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 8,521 | 8,811 | 11.29 | 11.55 | 101,318 | 103,669 | 9.36 | 9.52 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 8,514 | 8,829 | 11.27 | 11.56 | 101,364 | 103,669 | 9.36 | 9.51 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 8,521 | 8,823 | 11.27 | 11.56 | 102,027 | 104,129 | 9.41 | 9.55 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 8,535 | 8,823 | 11.27 | 11.54 | 101,718 | 104,154 | 9.35 | 9.53 |
| **Changes Between No-build and Build Alternatives** | | | | | | | | |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | -0.1% | 0.0% | 0.0% | 0.1% | -0.4% | 0.0% | -0.1% | 0.3% |
| Alternative 2: Bowker overpass at-grade | -0.2% | 0.0% | 0.0% | 0.2% | -0.3% | 0.0% | 0.3% | 0.4% |
| Alternative 3: New regional access | -1.4% | -0.1% | -0.4% | 0.2% | 0.0% | 0.0% | 2.3% | 0.8% |
| Alternative 4: New regional and local access | -5.2% | -0.4% | -2.4% | 0.8% | -1.0% | -0.6% | 2.0% | 0.7% |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 0.1% | -0.1% | 0.1% | 0.0% | -0.4% | -0.4% | -0.2% | -0.1% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 0.0% | 0.1% | -0.1% | 0.1% | -0.3% | -0.4% | -0.2% | -0.2% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 0.1% | 0.1% | -0.1% | 0.1% | 0.3% | 0.0% | 0.3% | 0.2% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 0.3% | 0.1% | -0.1% | -0.1% | 0.0% | 0.0% | -0.3% | 0.0% |

statistically significant differences in several alternatives, they likely would not be disproportionate differences. Average travel times remain relatively the same, with differences likely within the model's margin of error.

### 8.3.2 Mobility Analysis

Results from the mobility analysis are summarized in Table 8-6. In both the no-build and build alternatives travel times from minority TAZs are three minutes less than those from non-minority TAZs and remain essentially unchanged under all build alternatives. The average travel time to minority TAZs is two minutes shorter than it is to non-minority TAZs in the no-build alternative. The travel times remain essentially unchanged under the build alternatives.

The average travel time from low-income TAZs is approximately two- and one-half minutes shorter than it is from non-low-income TAZs in the no-build alternative. This proportion is not appreciably different from most build alternatives. Bowker Alternative 4: New Regional and Local Access, has the highest average travel times for both low-income and non-low-income TAZs. While there are some statistically significant differences, they do not represent practical differences, as the changes are less than 1.5%.

The average travel time to low-income TAZs is also consistently lower (almost two minutes) than it is for non-low-income TAZs under the no-build alternative and all build alternatives. While the increases are small, Bowker Alternative 4: New Regional and Local Access, has the highest average travel times for both low-income and non-low-income TAZs.

### 8.3.3 Environmental Impact Analysis

Results of environmental impact analyses are shown in Tables 8-7 and 8-8. These analyses focused on the impact to air quality with respect to congested roadway conditions. Overall, minority TAZs have more vehicle-miles traveled and CO emissions than non-minority TAZs under the no-build and build alternatives. Fine particulate matter pollution is the same for minority and non-minority TAZs under the no-build alternative. There are no statistically significant differences for minority TAZs among the build alternatives.

Low-income TAZs generally have more vehicle-miles traveled and CO emissions, and fine particulate matter pollution than non-low-income TAZs under the no-build and build alternatives. This is because low-income TAZs usually are located within highly traveled areas with dense stop-and-go traffic. There are no statistically significant differences for low-income TAZs among the build alternatives.

### 8.3.4 Bicycle and Pedestrian Impacts

Proposed pedestrian and bicycle regional connectivity improvements in the Bowker Overpass area and the Charles River Basin were qualitatively assessed for impacts on minority and low-income TAZs. The Overpass is located in TAZs that are both low-income and minority. Proposed sidewalk and crosswalk improvements and path connections will directly benefit these populations. Enhanced street connections and proposed paths in the Charles River Basin should benefit all populations.

## 8.4 CONCLUSION

The environmental-justice analysis indicates that the proposed alternatives would have minimal differences in accessibility, mobility, and environmental impacts when no-build and build alternatives are compared for both EJ-population TAZs and non–EJ TAZs. None of the proposed alternatives likely would place a disproportionate burden on the EJ-population TAZs.

**TABLE 8-6**
**Mobility Summary:**
**No-build and Build Alternatives**

| Location | Minority and Non-Minority TAZs | | | | Low-Income and Non Low-Income TAZs | | | |
|---|---|---|---|---|---|---|---|---|
| | Average Auto Production Time (Minutes) | | Average Auto Attraction Time (Minutes) | | Average Auto Production Time (Minutes) | | Average Auto Attraction Time (Minutes) | |
| | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority |
| No-build | 13.0 | 16.2 | 21.7 | 24.1 | 12.80 | 15.29 | 21.71 | 23.26 |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | 13.0 | 16.2 | 21.7 | 24.1 | 12.83 | 15.30 | 21.71 | 23.26 |
| Alternative 2: Bowker overpass at-grade | 13.0 | 16.2 | 21.7 | 24.2 | 12.84 | 15.30 | 21.72 | 23.27 |
| Alternative 3: New regional access | 13.1 | 16.2 | 21.7 | 24.2 | 12.90 | 15.32 | 21.76 | 23.27 |
| Alternative 4: New regional and local access | 13.1 | 16.3 | 21.8 | 24.2 | 12.98 | 15.40 | 21.88 | 23.35 |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 13.0 | 16.2 | 21.7 | 24.1 | 12.80 | 15.30 | 21.68 | 23.24 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 13.0 | 16.2 | 21.7 | 24.1 | 12.80 | 15.29 | 21.69 | 23.24 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 13.0 | 16.2 | 21.7 | 24.1 | 12.78 | 15.29 | 21.68 | 23.25 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 12.9 | 16.2 | 21.6 | 24.1 | 12.78 | 15.28 | 21.65 | 23.24 |
| **Changes Between No-build and Build Alternatives** | | | | | | | | |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | 0.0% | 0.0% | 0.0% | 0.0% | 0.2% | 0.1% | 0.0% | 0.0% |
| Alternative 2: Bowker overpass at-grade | 0.0% | 0.0% | 0.0% | 0.4% | 0.3% | 0.1% | 0.0% | 0.0% |
| Alternative 3: New regional access | 0.8% | 0.0% | 0.0% | 0.4% | 0.8% | 0.2% | 0.2% | 0.0% |
| Alternative 4: New regional and local access | 0.8% | 0.6% | 0.5% | 0.4% | 1.4% | 0.7% | 0.8% | 0.4% |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | -0.1% | -0.1% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 0.0% | 0.0% | 0.0% | 0.0% | -0.2% | 0.0% | -0.1% | 0.0% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | -0.8% | 0.0% | -0.5% | 0.0% | -0.2% | -0.1% | -0.3% | -0.1% |

**TABLE 8-7**
**Air-Quality Summary, Minority and Non-Minority TAZs:**
**No-build and Build Alternatives**

| Location | CO per Square Mile ($kg/mile^2$) | | PM2.5 per Square Mile ($kg/mile^2$) | | VMT per Square Mile | | Congested VMT Per Square Mile | |
|---|---|---|---|---|---|---|---|---|
| | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority |
| No-build | 471 | 435 | 37 | 37 | 138,400 | 126,740 | 2,158 | 1,860 |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | 466 | 435 | 37 | 37 | 136,517 | 126,913 | 2,135 | 1,858 |
| Alternative 2: Bowker overpass at-grade | 467 | 435 | 37 | 37 | 137,195 | 126,598 | 2,142 | 1,852 |
| Alternative 3: New regional access | 458 | 440 | 37 | 38 | 134,317 | 128,349 | 2,121 | 1,632 |
| Alternative 4: New regional and local access | 452 | 452 | 37 | 38 | 133,420 | 131,345 | 2,105 | 1,803 |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 453 | 431 | 37 | 37 | 133,388 | 125,457 | 2,103 | 1,872 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 451 | 431 | 37 | 37 | 133,234 | 125,072 | 2,077 | 1,914 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 451 | 430 | 37 | 37 | 132,680 | 125,884 | 2,031 | 1,929 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 451 | 430 | 37 | 37 | 132,980 | 125,862 | 2,022 | 1,925 |
| **Changes Between No-build and Build Alternatives** | | | | | | | | |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | -1.1% | 0.0% | 0.0% | 0.0% | -1.4% | 0.1% | -1.1% | -0.1% |
| Alternative 2: Bowker overpass at-grade | -0.8% | 0.0% | 0.0% | 0.0% | -0.9% | -0.1% | -0.7% | -0.4% |
| Alternative 3: New regional access | -2.8% | 1.1% | 0.0% | 2.7% | -3.0% | 1.3% | -1.7% | -12.3% |
| Alternative 4: New regional and local access | -4.0% | 3.9% | 0.0% | 2.7% | -3.6% | 3.6% | -2.5% | -3.1% |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | -3.8% | -0.9% | 0.0% | 0.0% | -3.6% | -1.0% | -2.5% | 0.6% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | -4.2% | -0.9% | 0.0% | 0.0% | -3.7% | -1.3% | -3.8% | 2.9% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | -4.2% | -1.1% | 0.0% | 0.0% | -4.1% | -0.7% | -5.9% | 3.7% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | -4.2% | -1.1% | 0.0% | 0.0% | -3.9% | -0.7% | -6.3% | 3.5% |

**TABLE 8-8**
**Air-Quality Summary, Low-Income and Non-Low-Income TAZs: No-build and Build Alternatives**

| Location | CO per Square Mile ($kg/mile^2$) | | PM2.5 per Square Mile ($kg/mile^2$) | | VMT per Square Mile | | Congested VMT Per Square Mile | |
|---|---|---|---|---|---|---|---|---|
| | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority | Minority | Non-Minority |
| No-build | 577 | 302 | 45 | 27 | 170,147 | 87,439 | 2,585 | 1,382 |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | 571 | 303 | 45 | 27 | 167,655 | 87,723 | 2,555 | 1,381 |
| Alternative 2: Bowker overpass at-grade | 572 | 303 | 45 | 27 | 168,506 | 87,520 | 2,582 | 1,352 |
| Alternative 3: New regional access | 561 | 307 | 44 | 27 | 164,362 | 89,379 | 2,533 | 1,241 |
| Alternative 4: New regional and local access | 550 | 318 | 44 | 28 | 162,633 | 92,148 | 2,491 | 1,382 |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | 553 | 302 | 44 | 27 | 163,568 | 86,991 | 2,494 | 1,419 |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | 553 | 299 | 44 | 27 | 163,542 | 86,511 | 2,491 | 1,405 |
| Alternative 3: New westbound off-ramp to Brookline Avenue | 552 | 299 | 44 | 27 | 162,904 | 86,960 | 2,439 | 1,407 |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | 553 | 299 | 44 | 27 | 163,258 | 86,976 | 2,449 | 1,377 |
| **Changes Between No-build and Build Alternatives** | | | | | | | | |
| **Bowker Overpass Alternatives** | | | | | | | | |
| Alternative 1: Bowker overpass removed | -1.0% | 0.3% | 0.0% | 0.0% | -1.5% | 0.3% | -1.2% | -0.1% |
| Alternative 2: Bowker overpass at-grade | -0.9% | 0.3% | 0.0% | 0.0% | -1.0% | 0.1% | -0.1% | -2.2% |
| Alternative 3: New regional access | -2.8% | 1.7% | -2.2% | 0.0% | -3.4% | 2.2% | -2.0% | -10.2% |
| Alternative 4: New regional and local access | -4.7% | 5.3% | -2.2% | 3.7% | -4.4% | 5.4% | -3.6% | 0.0% |
| **Back Bay Alternatives** | | | | | | | | |
| Alternative 1: New westbound off-ramp to Berkley | -4.2% | 0.0% | -2.2% | 0.0% | -3.9% | -0.5% | -3.5% | 2.7% |
| Alternative 2: New westbound off-ramp to Trinity Place/Berkley St. | -4.2% | -1.0% | -2.2% | 0.0% | -3.9% | -1.1% | -3.6% | 1.7% |
| Alternative 3: New westbound off-ramp to Brookline Avenue | -4.3% | -1.0% | -2.2% | 0.0% | -4.3% | -0.5% | -5.6% | 1.8% |
| Alternative 4: New eastbound on-ramp from the Bowker Overpass | -4.2% | -1.0% | -2.2% | 0.0% | -4.0% | -0.5% | -5.3% | -0.4% |

# Chapter 9—Screening Evaluation

## 9.1 INTRODUCTION

This chapter presents the preliminary screening that was used to compare the eight alternatives to the 2035 No-Build scenario and assesses their relative benefits and drawbacks.

## 9.2 SCREENING PROCESS AND CRITERIA

Eight alternatives were screened according to nine criterions:

- Traffic
- Motorized Circulation and Access
- Transit Circulation and Access
- Nonmotorized Circulation and Access
- Safety
- Neighborhood Impacts
- Environmental Impacts
- Business Considerations
- Cost

This section describes the measures that were considered under each criterion. For each measure, an alternative was assigned a score of -1, 0, or +1, depending on how it compared to the 2035 No-Build condition (Figure 9-1). For example, if the analysis showed that an alternative would increase vehicle emissions by more than 0.2% compared to the emissions predicted to occur in 2035 if no alternative is pursued, then this would be considered a negative impact, and the alternative would be assigned a score of -1. If the change from the No-Build condition is predicted to be relatively insignificant, the alternative would be given a score of 0.

**Figure 9-1**
**Impact Summary**

| Positive Impact | No Impact or Insignificant Impact | Negative Impact |
|---|---|---|
| +1 | 0 | -1 |

### 9.2.1 Traffic

Traffic was evaluated according to the delay reported by Synchro. The total delay in seconds for the AM and PM peak hours for specific intersections, which are common to all of the alternatives, was used. These regional intersections include:

- Park Drive at Brookline Avenue/Boylston Street
- Kenmore Square (Commonwealth Avenue/Brookline Avenue/Beacon Street)
- Massachusetts Avenue at Beacon Street
- Dartmouth Street at Saint James Avenue
- Arlington Street at Beacon Street
- Arlington Street at Stuart Street/Columbus Avenue
- Charlesgate East at Beacon Street
- Charlesgate West at Beacon Street
- Charlesgate West at Commonwealth Avenue Westbound
- Charlesgate West at Commonwealth Avenue Eastbound
- Charlesgate East at Commonwealth Avenue Westbound
- Charlesgate East at Commonwealth Avenue Eastbound
- Bowker Overpass at Boylston Street
- Charlesgate at Boylston Street and Fenway

If the delay was increased or decreased from the No-Build condition by more than 10%, the alternative was given a score of -1 or +1, respectively. If the delay did not change by more than 10%, the impact was assumed to be neutral and the alternative was assigned a score of 0.

### 9.2.2 Motorized Circulation and Access

The measures used to evaluate motorized circulation and access were travel times and vehicle route continuity/directness/connectivity.

Impacts to travel times were assessed by comparing total vehicle-hours traveled (VHT) in minutes for AM and PM peak hours in the study area. If VHT increased by more than 2% of the No-Build VHT level, the impact was considered a degradation and the alternative was given a score of -1; if the VHT decreased by more than 2%, it was considered an improvement, and the alternative was given a score of +1. A change of less than 2% was considered neutral, and the alternative was given a score of 0.

Vehicle route continuity/directness/connectivity was qualitatively assessed. For example, some alternatives improved connectivity by introducing a new off-ramp that provides a more direct connection.

### 9.2.3 Transit Circulation and Access

Changes in access for transit passengers and physical impacts to proposed transit alternatives were estimated. As with vehicle route continuity/directness/connectivity, this was a qualitative assessment. An example is assessing whether an alternative would impact a bus route and perhaps enhance the route.

### 9.2.4 Nonmotorized Circulation and Access

Bicycle and pedestrian circulation and access were qualitatively assessed based on perceptions of comfort, with consideration given to bike lanes, wide sidewalks, proximity to traffic, and other factors. The future Charlesgate Greenway was included in all scenarios, including the 2035 No-Build condition.

### 9.2.5 Safety

Safety impacts were assessed using five measures: vehicle crashes, bicycle/pedestrian separation from vehicular traffic, emergency vehicle access, highway operations, and geometrics.

For vehicle crashes, the results of the regional travel demand model were reviewed to determine whether traffic would increase through crash clusters. An increase was considered a negative impact and was assigned a score of -1, and a decrease was assigned a score of +1.

Bicycle and pedestrian safety was qualitatively assessed in terms of potential for bicycle-pedestrian conflicts. For example, increases in traffic on a roadway may prompt some bicyclists to ride on the sidewalk, which would increase the potential for conflicts with pedestrians.

Emergency vehicle access was qualitatively assessed by considering connectivity and directness, as well as changes in traffic congestion.

Highway operations were evaluated using Highway Capacity Software (HCS) to determine the level of service (LOS) on a new ramp or highway weaving section. Lower LOS indicates a negative impact and was assigned a score of -1.

### 9.2.6 Neighborhood Impacts

Neighborhood impacts include noise, aesthetics, and neighborhood cohesion.

Noise levels were evaluated for the alternatives and compared them to levels anticipated under the 2035 No-Build conditions. Traffic diversions were qualitatively assessed based on the results of the travel demand model. Increased noise levels have a negative effect, and elevated roadways impact aesthetics. Additionally, neighborhood cohesion was assessed by observing the travel demand model and estimating changes in traffic volumes and the resultant congestion. If volumes and congestion appeared to increase, it was considered a detriment to neighborhood cohesion.

### 9.2.7 Environmental Impacts

The environmental conditions that were considered include air quality, wetland impacts, hazardous material sites, historic districts and sites, and parks/open spaces.

Air quality was estimated from the travel demand model (metric tons of the total $CO_2$ equivalent of CO, NOx, and $CO_2$ for the AM and PM peak hours). Changes of more than 0.2% from the 2035 No-Build condition were considered positive (+1) or negative (–1) impacts.

The remaining factors (wetlands, hazardous material sites, historic districts and sites, and parks/open spaces) were assessed using the geographic information system (GIS) to determine whether the footprints of the alternatives impeded any resources.

### 9.2.8 Business Considerations

Business considerations include access and physical impacts to development sites; air rights; parking impacts; and truck circulation and access. The Boston Redevelopment Authority (BRA) provided information on which parcels have planned developments in order to determine if any were within the project area.

For air rights, the 2000 BRA report "A Civic Vision for Turnpike Air Rights in Boston" was used as a reference.

"Access to existing and future development sites" describes indirect impacts that do not require the structure on the property to be removed in order for the alternative to be built. "Physical impacts to development" are direct impacts in which the property overlaps the boundaries of the alternative; therefore, the structure itself would need to be either removed completely or reconstructed to allow for completion of the alternative.

Parking impacts were assessed by determining whether the footprint of the alternative infringed on existing on-street parking; if so, the number of spaces impacted was calculated by dividing the length of the infringement by 25 feet per vehicle. If 15 or more parking spaces were affected, this was considered a significant impact.

Truck circulation and access were qualitatively assessed by reviewing whether any dedicated truck routes would be impacted or whether traffic was forecasted to increase through any nonstandard facilities (e.g., intersections with acute angles).

### 9.2.9 Cost

The MassDOT Highway Division prepared conceptual estimates of construction costs associated with each of the Back Bay Ramps and Bowker Overpass alternatives. The

cost estimates only include estimated construction cost; no estimates have been provided for potential property impacts or other nonconstruction related costs. The MassDOT costs are provided in Appendix D.

# 9.3 SCREENING EVALUATION

The Back Bay Ramp and Bowker Overpass alternatives were evaluated using the previously described criteria. Table 9-1 summarizes the Back Bay Ramp alternatives, and Table 9-2 summarizes the Bowker Overpass alternatives.

## 9.3.1 Massachusetts Turnpike Back Bay Ramp Evaluations

The following section provides an explanation of each evaluation criteria for the Back Bay Ramp alternatives.

### *Back Bay Ramp Alternative 1: New Westbound Off-Ramp to Berkeley Street*

1. Traffic (Neutral): The AM and PM peak-hour delays were below the 10% difference threshold and therefore were given a neutral or 0 score. The AM change resulted in a decrease of 2%, and the PM change was an increase of 5%.
2. Motorized Circulation and Access (Positive): A positive or 1 score was given because it improves existing conditions by increasing the number of Massachusetts Turnpike westbound off-ramps by replacing an on-ramp with an off-ramp; currently, there are many more on-ramps than off-ramps (two off-ramps and seven on-ramps) in the westbound direction within the study area. However, Cortes Street would no longer connect between Arlington Street and Berkeley Street: it would dead end before connecting to Berkeley Street.
3. Transit Circulation and Access (Negative): There is a potential for increased traffic volumes on Saint James Avenue, which could impact nearby bus routes 9, 39, and10, resulting in a negative rating. However, there are no proposed transit changes in the study area, and existing bus routes do not use the existing Massachusetts Turnpike on-ramp from Arlington Street.
4. Nonmotorized Circulation and Access (Neutral): Closure of Cortes Street at its western end may force bicyclists to ride on busier streets. However, this is not a large enough of an impact to result in a negative rating and therefore is considered neutral.
5. Safety (Neutral): Due to an increase in vehicle traffic through the Saint James Avenue/Dartmouth Street and Exeter Street/Huntington Avenue intersections, which are both high crash cluster locations, there will be a negative rating. However, a positive improvement for emergency vehicle access is anticipated because of better connectivity and route directness. Therefore, an overall rating of neutral was given.

6. Neighborhood Impacts (Neutral): The proposed ramp is located in the same location of the current Arlington Street on-ramp, so there will be no change to existing conditions, resulting in a neutral rating.
7. Environmental Impacts (Positive): A positive score was given because of a slight improvement to air quality.
8. Business Considerations (Negative): Because the proposed on-ramp impacts with proposed Air Right Parcels 18, 19, and 20, a negative rating was given.

## TABLE 9-1
## Massachusetts Turnpike Back Bay Ramp Alternatives Screening Summary

| Evaluation | Measure | Back Bay Ramp Alternative 1 | Back Bay Ramp Alternative 2 | Back Bay Ramp Alternative 3 | Back Bay Ramp Alternative 4 |
|---|---|---|---|---|---|
| Traffic | Delay | 0 | 0 | 0 | 0 |
| | Overall Traffic Rating | Neutral | Neutral | Neutral | Neutral |
| Motorized Circulation and Access | Travel Times | 0 | 0 | 0 | 0 |
| | Vehicle Route Continuity/Directness/Connectivity | +1 | 0 | +1 | +1 |
| | Traffic Diversions | 0 | 0 | +1 | 0 |
| | Overall Motorized Circulation and Access Rating | Positive | Neutral | Positive | Positive |
| Transit Circulation and Access | Changes in Access for Transit Passengers | -1 | -1 | -1 | 0 |
| | Physical Impact to Proposed Transit | 0 | 0 | 0 | 0 |
| | Overall Transit Circulation and Access Rating | Negative | Negative | Negative | Neutral |
| Nonmotorized Circulation and Access | Bicycle and Pedestrian Access | 0 | 0 | -1 | 0 |
| | Overall Nonmotorized Circulation and Access Rating | Neutral | Neutral | Negative | Neutral |
| Safety | Vehicle Crashes | -1 | -1 | 0 | 0 |
| | Changes in Bicycle and Pedestrian Route Separation | 0 | 0 | 0 | 0 |
| | Changes in Emergency Vehicle Access | +1 | 0 | 0 | 0 |
| | Highway Operations | 0 | 0 | -1 | 0 |
| | Overall Safety Rating | Neutral | Negative | Negative | Neutral |
| Neighborhood Impacts | Noise | 0 | 0 | 0 | 0 |
| | Aesthetics | 0 | 0 | 0 | -1 |
| | Neighborhood Cohesion | 0 | 0 | +1 | +1 |
| | Overall Neighborhood Impacts Rating | Neutral | Neutral | Positive | Neutral |
| Environmental Impacts | Air Quality | +1 | +1 | +1 | 0 |
| | Wetlands | 0 | 0 | 0 | 0 |
| | Hazardous Material Sites | 0 | 0 | 0 | 0 |
| | Historic Districts and Sites | 0 | 0 | 0 | -1 |
| | Parks/Open Space | 0 | -1 | 0 | 0 |
| | Overall Environmental Impacts Rating | Positive | Neutral | Positive | Negative |
| Business Considerations | Access to Existing and Future Developments Sites (Indirect Impacts) | 0 | 0 | 0 | 0 |
| | Physical Impacts to Developments (Direct Impacts) | 0 | -1 | 0 | 0 |
| | Air Rights | -1 | -1 | -1 | 0 |
| | Parking Impacts | 0 | 0 | -1 | -1 |
| | Truck Circulation and Access | 0 | 0 | 0 | 0 |
| | Overall Business Considerations Rating | Negative | Negative | Negative | Negative |
| | Summary Comments | Cost: $100,800,000<br>2 Conditions improved<br>4 Conditions not significantly impacted<br>2 Conditions worsened | Cost: $122,700,000<br>0 Conditions improved<br>5 Conditions not significantly impacted<br>3 Conditions worsened | Cost: $52,400,000<br>3 Conditions improved<br>1 Conditions not significantly impacted<br>4 Conditions worsened | Cost: $137,100,000<br>1 Condition improved<br>5 Conditions not significantly impacted<br>2 Conditions worsened |

**TABLE 9-2**
**Bowker Overpass Alternatives Screening Summary**

| Evaluation | Measure | Bowker Overpass Alternative 1 | Bowker Overpass Alternative 2 | Bowker Overpass Alternative 3 | Bowker Overpass Alternative 4 |
|---|---|---|---|---|---|
| Traffic | Delay | -1 | -1 | -1 | -1 |
| | Overall Traffic Rating | Negative | Negative | Negative | Negative |
| Motorized Circulation and Access | Travel Times | 0 | 0 | 0 | 0 |
| | Vehicle Route Continuity/Directness/Connectivity | -1 | 0 | 0 | +1 |
| | Traffic Diversions | 0 | 0 | 0 | +1 |
| | Overall Motorized Circulation and Access Rating | Negative | Neutral | Neutral | Positive |
| Transit Circulation and Access | Changes in Access for Transit Passengers | -1 | 0 | 0 | 0 |
| | Physical Impact to Proposed Transit | 0 | 0 | 0 | 0 |
| | Overall Transit Circulation and Access Rating | Negative | Neutral | Neutral | Neutral |
| Nonmotorized Circulation and Access | Bicycle and Pedestrian Access | -1 | -1 | -1 | -1 |
| | Overall Nonmotorized Circulation and Access Rating | Negative | Negative | Negative | Negative |
| Safety | Vehicle Crashes | -1 | -1 | -1 | -1 |
| | Changes in Emergency Vehicle Access | -1 | -1 | -1 | -1 |
| | Highway Operations | 0 | 0 | 0 | 0 |
| | Overall Safety Rating | Negative | Negative | Negative | Negative |
| Neighborhood Impacts | Noise | 0 | +1 | 0 | +1 |
| | Aesthetics | +1 | +1 | +1 | +1 |
| | Neighborhood Cohesion | -1 | -1 | 0 | 0 |
| | Overall Neighborhood Impacts Rating | Neutral | Positive | Positive | Positive |
| Environmental Impacts | Air Quality | +1 | 0 | -1 | -1 |
| | Wetlands | 0 | 0 | 0 | 0 |
| | Hazardous Material Sites | 0 | 0 | 0 | 0 |
| | Historic Districts and Sites | -1 | -1 | -1 | -1 |
| | Parks/Open Space | 0 | -1 | +1 | +1 |
| | Overall Environmental Impacts Rating | Neutral | Negative | Negative | Negative |
| Business Considerations | Access to Existing and Future Developments Sites (Indirect Impacts) | 0 | 0 | 0 | 0 |
| | Physical Impacts to Developments (Direct Impacts) | 0 | 0 | 0 | 0 |
| | Air Rights | 0 | 0 | 0 | 0 |
| | Parking Impacts | 0 | 0 | 0 | 0 |
| | Truck Circulation and Access | 0 | 0 | 0 | 0 |
| | Overall Business Considerations Rating | Neutral | Neutral | Neutral | Neutral |
| | Summary Comments | Cost $46,200,000<br>0 Conditions improved<br>3 Conditions not significantly impacted<br>5 Conditions worsened | Cost $51,400,000<br>1 Condition improved<br>3 Conditions not significantly impacted<br>4 Conditions worsened | Cost $212,000,000<br>1 Condition improved<br>3 Conditions not significantly impacted<br>4 Conditions worsened | Cost $325,000,000<br>2 Conditions improved<br>2 Conditions not significantly impacted<br>4 Conditions worsened |

9. Cost: A cost of $100,800,000 is for the direct construction costs. This number does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Back Bay Ramp Alternative 1 indicates that it would improve two conditions (Motorized Circulation and Access and Environmental Impacts) and it would worsen two conditions (Transit Circulation and Access and Business Considerations); four conditions would remain the same or neutral (Traffic, Nonmotorized Circulation and Access, Safety, and Neighborhood Impacts).

## Back Bay Ramp Alternative 2: New Westbound Off-Ramp to Trinity Place/Stuart Street

1. Traffic (Neutral): The AM and PM peak-hour delays were below the 10% difference threshold and therefore were given a neutral or 0 score. The AM change resulted in a decrease of 2%, and the PM the change was an increase of less than 0.5%.
2. Motorized Circulation and Access (Neutral): It improves existing conditions by increasing the number of off-ramps in the study area (currently, two off-ramps and seven on-ramps). However, a 0 or neutral score was given because of the removal of two-westbound on-ramps. In addition, this new off-ramp may not be as direct: most traffic using the new off-ramp does a slight U-turn as it heads north on Trinity Place and then west and southwest on Saint James Street/Huntington Avenue.
3. Transit Circulation and Access (Negative): There are potential impacts due to increased traffic volumes, which could impact nearby bus routes 9, 39, 10, 170, 502, and 503; therefore, a negative rating was given.
4. Nonmotorized Circulation and Access (Neutral): There are no apparent changes in the study area because of the new off-ramp; therefore, a neutral score was given.
5. Safety (Negative): Because of an increase in vehicle traffic through the Saint James Avenue/Dartmouth Street and Exeter Street/Huntington Avenue intersections, both high crash cluster locations, a negative rating was given.
6. Neighborhood Impacts (Neutral): Traffic impacts are mostly limited to the Massachusetts Turnpike westbound and the Bowker Overpass/Charlesgate areas. Because there are no significant increases in traffic volumes, a neutral score was given.
7. Environmental Impacts (Neutral): The proposed ramp does improve air quality; however there is an impact to the Frieda Garcia Park with the new off-ramp, so a neutral rating was given.
8. Business Considerations (Negative): The proposed on-ramp impacts with proposed Air Right Parcels 16 and 17. It also impacts the John Hancock Parking Garage. Therefore, a negative rating was given.

9. Cost: A cost of $122,700,000 is for the direct construction costs. This number does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Back Bay Ramp Alternative 2 indicates that it would not improve any conditions and it would worsen three conditions (Transit Circulation and Access, Safety, and Business Considerations); five conditions would remain the same or neutral (Traffic, Motorized Circulation and Access, Nonmotorized Circulation and Access, Neighborhood Impacts, and Environmental Impacts).

## *Back Bay Ramp Alternative 3: New Westbound Off-Ramp to Brookline Avenue*

1. Traffic (Neutral): The AM and PM peak-hour delays were below the 10% difference threshold and therefore were given a neutral or 0 score. The AM change resulted in a decrease of 2%, and the PM change was an increase of 3%.
2. Motorized Circulation and Access (Positive): It improves existing conditions by increasing the number of off-ramps in the study area (currently, two off-ramps and seven on-ramps). A +1 or positive score was given because of the increased access to the Longwood Medical Area (LMA) and Fenway neighborhood. There is a minor impact to the Newbury Street extension since it will no longer connect to Brookline Avenue.
3. Transit Circulation and Access (Negative): There is the likelihood of increased traffic volumes on Brookline Avenue and at Kenmore Square, which has potential impacts to nearby bus routes 8, 19, 60, and 65; therefore, a negative rating was given.
4. Nonmotorized Circulation and Access (Negative): The presence of the Kenmore Massachusetts Bay Transportation Authority (MBTA) station and the retail and commercial activity in Kenmore Square to the north of the proposed off-ramp intersection, as well as Fenway Park and the retail and desirable destinations along Brookline Avenue and Lansdowne Street to the south, create significant pedestrian travel along Brookline Avenue that could be impacted by the increased traffic along Brookline Avenue due to the new off-ramp.
5. Safety (Negative): Because of a new weave section being created on the Massachusetts Turnpike between the existing Massachusetts on-ramp and the proposed off-ramp, a negative rating was given.
6. Neighborhood Impacts (Positive): The proposed ramp results in slight decreases in traffic volumes on the study area's streets, so a positive score was given.
7. Environmental Impacts (Positive): Because the proposed ramp does improve air quality, a positive rating was given.
8. Business Considerations (Negative): The proposed on-ramp impacts with proposed Air Right Parcels 12, 13, 14, and 15. It will also impact the Hotel

Commonwealth's expansion and result in the removal of approximately 60 on-street parking spaces. Therefore, a negative rating was given.

9. Cost: A cost of $52,400,000 is for the direct construction costs. It does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Back Bay Ramp Alternative 3 indicates that it would improve three conditions (Motorized Circulation and Access, Neighborhood Impacts, and Environmental Impacts) and it would worsen four conditions (Transit Circulation and Access, Nonmotorized Circulation and Access, Safety, and Business Considerations); one condition would remain the same or neutral (Traffic and Nonmotorized Circulation and Access).

### *Back Bay Ramp Alternative 4: New Eastbound On-Ramp from the Bowker Overpass*

1. Traffic (Neutral): The AM and PM peak-hour delays were below the 10% difference threshold and therefore were given a neutral or 0 score. The AM change resulted in a decrease of 2%, and the PM change was an increase of less than 1%.
2. Motorized Circulation and Access (Positive): It improves existing conditions by providing an eastbound on-ramp for the LMA and Fenway neighborhood as well as some parts of the Back Bay neighborhoods, improving regional access from these neighborhoods. Therefore, a +1 or positive score was given.
3. Transit Circulation and Access (Neutral): There are no apparent impacts to nearby bus routes 8, 19, 60, and 65; therefore, a neutral rating was given.
4. Nonmotorized Circulation and Access (Neutral): There are no apparent impacts or improvements for pedestrians and bicyclists; therefore, a neutral score was given.
5. Safety (Neutral): Because there are no apparent impacts or improvements, a neutral score was given.
6. Neighborhood Impacts (Neutral): The proposed ramp results in slight decreases in traffic volumes on the study area's streets, but there is an increase in traffic volume to the Massachusetts Turnpike eastbound. There is also an aesthetics impact due to the new on-ramp coming down from the Bowker Overpass, which affects the park. Therefore, a neutral score was given.
7. Environmental Impacts (Negative): The proposed ramp impacts the Olmstead Park System and could potentially impact the historic Fenway Studios, so a negative rating was given.
8. Business Considerations (Negative): The proposed on-ramp impacts with proposed Air Right Parcels 10 and 11. It will also result in the removal of approximately 70 on-street parking spaces on Newbury Street as a result of the

relocation of the Massachusetts Turnpike's alignment to the north. Therefore, a negative rating was given.

9. Cost: A cost of $137,100,000 is for the direct construction costs. It does not include potential mitigation, property, or engineering costs associated with the new on-ramp.

Overall, the evaluation of Back Bay Ramp Alternative 4 indicates that it would only improve one condition (Motorized Circulation and Access) and it would worsen two conditions (Environmental Impacts and Business Considerations); five conditions would remain the same or neutral (Traffic, Transit Circulation and Access, Nonmotorized Circulation and Access, Safety, and Neighborhood Impacts).

### 9.3.2 Bowker Overpass Evaluations

The following section provides an explanation of each evaluation criteria for the Bowker Overpass alternatives.

#### *Bowker Overpass Alternative 1: Bowker Overpass Removed*

1. Traffic (Negative): The AM and PM peak-hour delays were both well above the 10% difference threshold and therefore were given a negative score. The change resulted in an increase of 79% and 102% in the AM and PM peak hours, respectively.
2. Motorized Circulation and Access (Negative): A negative score was given because of the removal of the Bowker Overpass and the north-south connection from Storrow Drive to the LMA and Fenway neighborhood.
3. Transit Circulation and Access (Negative): There are potential impacts because of increased traffic volumes on Beacon Street and to Kenmore Square, which will impact bus operations; therefore, a negative rating was given.
4. Nonmotorized Circulation and Access (Negative): A negative score was given because of the increase in traffic volumes on local streets, making it more challenging for pedestrians and bicyclists.
5. Safety (Negative): Because of an increase in vehicle traffic, there could be an increase in the number of crashes, leading to potential impacts to emergency vehicles because of lowered direct connectivity with LMA destinations; therefore, a negative score was given.
6. Neighborhood Impacts (Neutral): There are trade-offs to neighborhood impacts with the removal of the Bowker Overpass. It eliminates high traffic volumes from an elevated roadway, helping to reduce noise impacts. It also eliminates a physical barrier in the middle of the park/open space areas. However, with the overpass removal and higher traffic volumes on other streets, it could create other neighborhood barriers. Therefore, a neutral rating was given.
7. Environmental Impacts (Neutral): Although air quality would be improved, this alternative has the potential of negatively impacting the Back Bay Historic and

Architectural districts as well as the Olmstead Park System. Therefore, a neutral rating was given.

8. Business Considerations (Neutral): A neutral score was given to this alternative.
9. Cost: A cost of $46,200,000 is for the direct construction costs. It does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Bowker Overpass Alternative 1 indicates that no conditions would improve and five conditions would worsen (Traffic, Motorized Circulation and Access, Transit Circulation and Access, Nonmotorized Circulation and Access, and Safety); three conditions would remain the same or neutral (Neighborhood Impacts, Environmental Impacts, and Business Considerations).

### *Bowker Overpass Alternative 2: At-Grade Bowker Overpass*

1. Traffic (Negative): The PM peak-hour delays were increased by 14%, above the 10% difference threshold; therefore, a negative score was given.
2. Motorized Circulation and Access (Neutral): A neutral score was given because all connections are restored to the existing conditions with the at-grade roadway.
3. Transit Circulation and Access (Neutral): Because the at-grade roadway still provides the existing connections, there are no apparent impacts to transit; therefore, a neutral rating was given.
4. Nonmotorized Circulation and Access (Negative): Because of the increase in traffic volumes with the at-grade Bowker Overpass, conditions would be more challenging for pedestrians and bicyclists. Therefore, a negative score was given.
5. Safety (Negative): The new at-grade roadway introduces three new signalized intersections, which increase the potential conflicts between vehicles, pedestrians, and bicyclists. Therefore, a negative score was given. .
6. Neighborhood Impacts (Positive): A positive score was given because of the removal of the bridge structure.
7. Environmental Impacts (Negative): There are impacts to the area's historic and architectural districts. It also significantly impacts the park and open space areas. Therefore, a negative score was given.
8. Business Considerations (Neutral): A neutral score was given to this alternative.
9. Cost: The cost of $51,400,000 is for the direct construction costs. It does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Bowker Overpass Alternative 2 indicates that it would improve one condition (Neighborhood Impacts) and would worsen four conditions (Traffic, Nonmotorized Circulation and Access, Safety, and Environmental Impacts);

three conditions would remain the same or neutral (Motorized Circulation and Access, Transit Circulation and Access, and Business Considerations).

### Bowker Overpass Alternative 3: New Regional Access

1. Traffic (Negative): There were significant delay increases in both peak hours. The AM peak hour increased by 14%, and the PM peak hour increased by 63%; therefore, a negative score was given.
2. Motorized Circulation and Access (Neutral): A neutral score was given because of improved regional access to and from the Massachusetts Turnpike with the new interchange, which offsets the lack of a direct connection from Storrow Drive across the Massachusetts Turnpike.
3. Transit Circulation and Access (Neutral): The new interchange does not affect existing bus routes; therefore, a neutral rating was given.
4. Nonmotorized Circulation and Access (Negative): The increase in traffic on the local streets will make bicycle and pedestrian movements more challenging; therefore, a negative score was given.
5. Safety (Negative): Based on the increase of traffic on some streets and the likelihood of bicyclists riding on sidewalks as the traffic volumes increase, a negative score was given.
6. Neighborhood Impacts (Positive): Because of the removal of the bridge structure and the increase in area to the park, a positive score was given.
7. Environmental Impacts (Negative): An overall negative score was given because of the impact to the area's historic and architectural districts as well as the impact to air quality. The improved park space does not mitigate these other impacts.
8. Business Considerations (Neutral): A neutral score was given to this alternative.
9. Cost: A cost of $212,000,000 is for the direct construction costs. It does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Bowker Overpass Alternative 3 indicates that only one condition would improve (Neighborhood Impacts) and four conditions would worsen (Traffic, Nonmotorized Circulation and Access, Safety, and Environmental Impacts); three conditions would remain the same or neutral (Motorized Circulation and Access, Transit Circulation and Access, and Business Considerations).

### Bowker Overpass Alternative 4: New Regional and Local Access

1. Traffic (Negative): The AM peak hour increased by 40% and the PM peak hour increased by 46%, both over the 10% threshold; therefore, a negative score was given.

2. Motorized Circulation and Access (Positive): A positive score was given because of improved access between Massachusetts Avenue and Storrow Drive, as well as regional access to and from the Massachusetts Turnpike.
3. Transit Circulation and Access (Neutral): The new interchange and Storrow Drive connection to Massachusetts Avenue does not affect existing bus routes; therefore, a neutral rating was given.
4. Nonmotorized Circulation and Access (Negative): Based on an increase in traffic on some local streets, a negative score was given.
5. Safety (Negative): Based on an increase of traffic on some streets and the likelihood of bicyclists riding on sidewalks (which could impact pedestrians) as the traffic volumes increase, a negative score was given.
6. Neighborhood Impacts (Positive): A positive score was given based on the removal of the bridge structure and the increase in area to the park. In addition, traffic is diverted over a number of streets.
7. Environmental Impacts (Negative): An overall negative score was given because of the impact to the area's historic and architectural districts as well as the impact to air quality. The improved park space does not mitigate these other impacts.
8. Business Considerations (Neutral): A neutral score was given to this alternative.
9. Cost: A cost of $325,000,000 is for the direct construction costs. It does not include potential mitigation, property, or engineering costs associated with the new off-ramp.

Overall, the evaluation of Bowker Overpass Alternative 4 indicates that two conditions would improve (Motorized Circulation and Access and Neighborhood Impacts) and four conditions would worsen (Traffic, Nonmotorized Circulation and Access, Safety, and Environmental Impacts); two conditions would remain the same or neutral (Transit Circulation and Access and Business Considerations).

# Chapter 10—Summary and Conclusions

## 10.1 SUMMARY

This section presents a summary of the analysis performed for the Massachusetts Turnpike Back Bay Ramps and Bowker Overpass Study. The purposes of the study were to 1) evaluate the feasibility of providing additional access to the Massachusetts Turnpike Boston Extension to improve the flow of traffic to Back Bay; and 2) develop alternatives to replace the existing Bowker Overpass. This study evaluated each of the purposes separately to meet the overall goals and objectives of the study.

### 10.1.1 Goals and Objectives

This study has four main goals that were developed through previous study efforts and the associated public process:

- Reduce traffic within the study area on the arterials and local streets
- Improve highway connections between Back Bay and crucial locations to the east, including but not limited to the Seaport District and Logan Airport
- Improve regional highway connections to the Longwood Medical Area (LMA) without having an impact on local roads
- Determine locations to reconstruct parkways and related roadway elements to lower capacity standards

Practical objectives for this study were developed to support the four goals:

- Identify locations on I-90 in Boston where the addition of an eastbound on-ramp or westbound off-ramp would be feasible with respect to design and highway operations
- Estimate the traffic benefits of the feasible new ramps with regard to both reducing travel times between selected origins and destinations and reducing traffic on surface streets
- Evaluate potential negative impacts of new ramps with respect to pedestrian safety, neighborhood character, and environmental justice
- Consider possible roadway and intersection configurations that would eliminate the Bowker Overpass
- Present a broader picture of possible project elements, along with their positive and negative impacts

# 10.2 ALTERNATIVES

## 10.2.1 Massachusetts Turnpike Back Bay Ramp Alternatives

At the beginning stages of the study process to develop a new ramp, seven ramp alternatives were partially developed based on previous studies. The initial screening provided four alternatives that were selected to be further developed and evaluated:

- Back Bay Alternative 1: New Westbound Off-Ramp to Berkeley Street
- Back Bay Alternative 2: New Westbound Off-Ramp to Trinity Place/Stuart Street
- Back Bay Alternative 3: New Westbound Off-Ramp to Brookline Avenue
- Back Bay Alternative 4: New Eastbound On-Ramp from the Bowker Overpass

A summary of each alternative's benefits and issues/impacts is provided in Table 10-1.

## 10.2.2 Bowker Overpass Alternatives

Four alternatives were "sketched" out in response to many organizations that had shown interest in altering or removing the Bowker Overpass. These preliminary alternatives have been further refined to meet this study's goals. The four final Bowker Overpass alternatives are:

- Bowker Overpass Alternative 1: Bowker Overpass Removed
- Bowker Overpass Alternative 2: Bowker Overpass At-Grade
- Bowker Overpass Alternative 3: New Regional Access
- Bowker Overpass Alternative 4: New Regional and Local Access

A summary of each alternative's benefits and issues/impacts is provided in Table 10-2.

**TABLE 10-1**
**Massachusetts Turnpike Back Bay Alternatives**

| Alternatives | Benefits | Issues/Impacts |
|---|---|---|
| Alternative 1: New Westbound Off-Ramp to Berkeley Street | • Direct access from I-93, I-90, Logan Airport, and South Boston to the Back Bay | • Closure of existing I-90 Eastbound on-ramp at Arlington Street<br>• Reconstruction of Arlington Street and Tremont Street bridge structures over the Massachusetts Turnpike in order to accommodate proposed deceleration lane and off-ramp<br>• The three existing signalized intersections would be reconstructed<br>• Marginal Road would be reduced to a single lane as it approaches Tremont Street<br>• On-street parking on Marginal Road (Massachusetts Turnpike side) would be impacted because of widening for proposed off-ramp<br>• Closure of Cortes Street to through traffic |
| Alternative 2: New Westbound Off-Ramp to Trinity Place/Stuart Street | • Direct access from I-93, I-90, Logan Airport, and South Boston to the Back Bay | • Closure of existing I-90 Eastbound on-ramps at Arlington Street and Clarendon Street<br>• Reconstruction of Berkeley Street, Columbus Avenue, and Clarendon Street bridge structures over Massachusetts Turnpike in order to accommodate proposed deceleration lane and off-ramp<br>• Impacts to the Frieda Garcia Park<br>• Major reconstruction of the Hancock Garage to accommodate off-ramp tunnel to Trinity Place |
| Alternative 3: New Westbound Off-Ramp to Brookline Avenue | • Direct access from I-93, I-90, Logan Airport, and South Boston to the Fenway area and LMA | • Potentially could require closure of existing I-90 Eastbound on-ramp at Massachusetts Avenue because of short weaving distance<br>• Newbury Street would require reconstruction and reduction of available on-street parking<br>• Newbury Street would no longer be a connection through to Brookline Avenue<br>• Currently the Hotel Commonwealth is expanding its parking area; proposed ramp would impact access to the hotel<br>• New off-ramp would impact access to 657 and 667 Boylston Street properties (buildings located north of Newbury Street adjacent to proposed ramp)<br>• New Brookline Avenue signalized intersection located approximately 150 feet south of Kenmore Square intersection would impact Kenmore Square traffic operations |
| Alternative 4: New Eastbound On-Ramp from the Bowker Overpass | • Direct access from LMA and Fenway to I-90, I-93, Logan Airport, and South Boston | • Major reconstruction and shift of Massachusetts Turnpike to the north<br>• Newbury Street, east of the Bowker Overpass, would no longer connect to Charlesgate East<br>• Severe impacts to Newbury Street and the adjacent properties<br>• Impacts to the new addition at the Hotel Commonwealth |

**TABLE 10-2**
**Bowker Overpass Alternatives**

| Alternatives | Benefits | Issues/Impacts |
|---|---|---|
| Alternative 1: Bowker Overpass Removed | • The reconstructed bridge structure over the Massachusetts Turnpike and reconstructed Charlesgate East and West provide an opportunity to improve pedestrian and bicycle accommodations<br>• Removal of the Bowker Overpass allows for an increase in the park's open space | • Still does not provide for improved access to the Charles River and pathways<br>• Removal of the overpass requires that Charlesgate East and West carry a significant increase in traffic volumes<br>• Increase in traffic volumes on Charlesgate East and West would significantly impact the adjacent residential buildings<br>• Increase in Charlesgate traffic volumes would impact pedestrian east/west flows<br>• Decrease in available traffic capacity from Storrow Drive over the Massachusetts Turnpike would cause traffic diversions to other streets, specifically Kenmore Square |
| Alternative 2: Bowker Overpass At-Grade | • The reconstructed bridge structure over the Massachusetts Turnpike and reconstructed Charlesgate East and West provides an opportunity to improve pedestrian and bicycle accommodations<br>• Moves the higher traffic volumes away from the adjacent residences | • New at-grade roadway creates a new east/west barrier for pedestrians and bicyclists<br>• New at-grade roadway increases the impact to the park's open space<br>• Still does not provide for improved access to the Charles River and pathways<br>• Increases delays and conflicts to vehicles, pedestrians, and bicyclists with the introduction of three new signalized intersections |
| Alternative 3: New Regional Access | • The reconstructed bridge structure over the Massachusetts Turnpike provides an opportunity to improve pedestrian and bicycle accommodations<br>• New regional access from the Massachusetts Turnpike is provided<br>• Removal of the Bowker Overpass allows for an increase in the park's open space | • Shifting the Massachusetts Turnpike northward significantly impacts the properties along Newbury Street<br>• Requires removal of the existing Massachusetts Avenue westbound on-ramp<br>• Still does not provide for improved access to the Charles River and pathways<br>• Increases diverted traffic from Storrow Drive to other routes |
| Alternative 4: New Regional and Local Access | • The reconstructed bridge structure over the Massachusetts Turnpike provides an opportunity to improve pedestrian and bicycle accommodations<br>• New regional access from the Massachusetts Turnpike is provided<br>• Removal of the Bowker Overpass allows for an increase in the park's open space<br>• Realignment of Storrow Drive increases the park's open space and provides an opportunity to improve access to the Charles River and its multi-use pathway<br>• Maintains access to the Back Bay, Fenway, and LMA areas from Storrow Drive | • Shifting the Massachusetts Turnpike northward significantly impacts the properties along Newbury Street<br>• Requires removal of the existing Massachusetts Avenue westbound on-ramp<br>• Constructs two new signalized intersections on heavily traveled Massachusetts Avenue<br>• Increases diverted traffic from Storrow Drive to Massachusetts Avenue and Kenmore Square |

# 10.3 SCREENING EVALUATION

The Back Bay Ramp and Bowker Overpass alternatives were compared to the No-Build scenario to assess their relative benefits and drawbacks. The alternatives were screened according to nine criterions:

- Traffic
- Motorized circulation and access
- Transit circulation and access
- Non-motorized circulation and access
- Safety
- Neighborhood impacts
- Environmental impacts
- Business considerations
- Cost

For each measure, an alternative was assigned a +1, 0, or -1 according to how it compared to the 2035 No-Build conditions (Tables 9-1 and 9-2). For example, if the analysis showed that an alternative would increase vehicle emissions by more than 0.2% compared to the emissions that are predicted to occur in 2035 if no alternative is pursued, then this would be considered a negative impact and the alternative would be assigned -1for that measure. If the change from the No-Build condition was relatively insignificant, then the alternative would be given a 0. Then each criterion then was given a positive, neutral, or negative rating based on the sum of the measures within each criterion. Table 10-3 provides a summary for each of the alternatives except for cost.

Overall, none of the Back Bay Ramp alternatives or the Bowker Overpass alternatives ranked positively. Only Back Bay Ramp Alternatives 1 and 3 had an overall rank of neutral. The rest of the alternatives had overall ranks of negative.

# 10.4 CONCLUSIONS

As this study proceeded from initial public meetings to this final report, staff reached a number of conclusions by carefully reviewing the evaluation results, and considering the communities' input at public meetings and their written comments:

- Based on the study and evaluation of the Back Bay Ramp and Bowker Overpass alternatives, there is no single alternative that is recommended for further study or implementation. As the evaluation indicates, there are no alternatives, as presently developed and evaluated, that meet the study's goals and objectives.
- The estimated construction cost of the alternatives cannot be justified, since no one alternative for the Back Bay Ramps or the Bowker Overpass satisfies the goals of the study.

**Table 10-3**
**Evaluation Summary**

| Evaluation | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
|---|---|---|---|---|
| **Massachusetts Turnpike Back Bay Ramps** | | | | |
| Traffic | Neutral | Neutral | Neutral | Neutral |
| Motorized Circulation and Access | Positive | Neutral | Positive | Positive |
| Transit Circulation and Access | Negative | Negative | Negative | Neutral |
| Non-Motorized Circulation and Access | Neutral | Neutral | Negative | Neutral |
| Safety | Neutral | Negative | Negative | Neutral |
| Neighborhood Impacts | Neutral | Neutral | Positive | Neutral |
| Environmental Impacts | Positive | Positive | Positive | Negative |
| Business Considerations | Negative | Negative | Negative | Negative |
| Overall | Neutral | Negative | Negative | Negative |
| **Bowker Overpass** | | | | |
| Traffic | Negative | Negative | Negative | Negative |
| Motorized Circulation and Access | Negative | Neutral | Neutral | Positive |
| Transit Circulation and Access | Neutral | Neutral | Neutral | Neutral |
| Non-Motorized Circulation and Access | Negative | Negative | Negative | Negative |
| Safety | Negative | Negative | Negative | Negative |
| Neighborhood Impacts | Neutral | Positive | Positive | Positive |
| Environmental Impacts | Neutral | Negative | Negative | Negative |
| Business Considerations | Neutral | Neutral | Neutral | Neutral |
| Overall | Negative | Negative | Negative | Negative |

- None of the proposed Bowker Overpass alternatives provided a suitable direct replacement to serve the regional traffic issue and meet the study's goals and objectives. Alternative 2, which replaces the overpass with at-grade roadways, creates major traffic issues and significantly affects the park's open space. The other alternatives create traffic diversions to other roadways and neighborhoods—in some cases, with a significant construction cost.
- Analysis of a recent MassDOT project at the Allston I-90 Interchange was not part of this study. Any future Back Bay Ramps or Bowker Overpass studies should include the proposed realignment of that interchange and potential impacts to the Massachusetts Turnpike and Bowker Overpass.